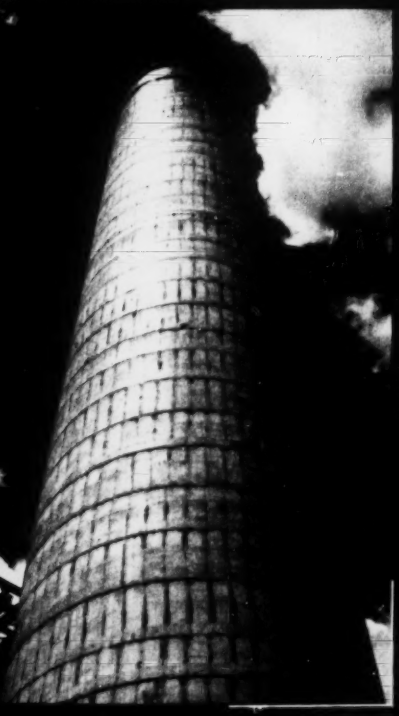
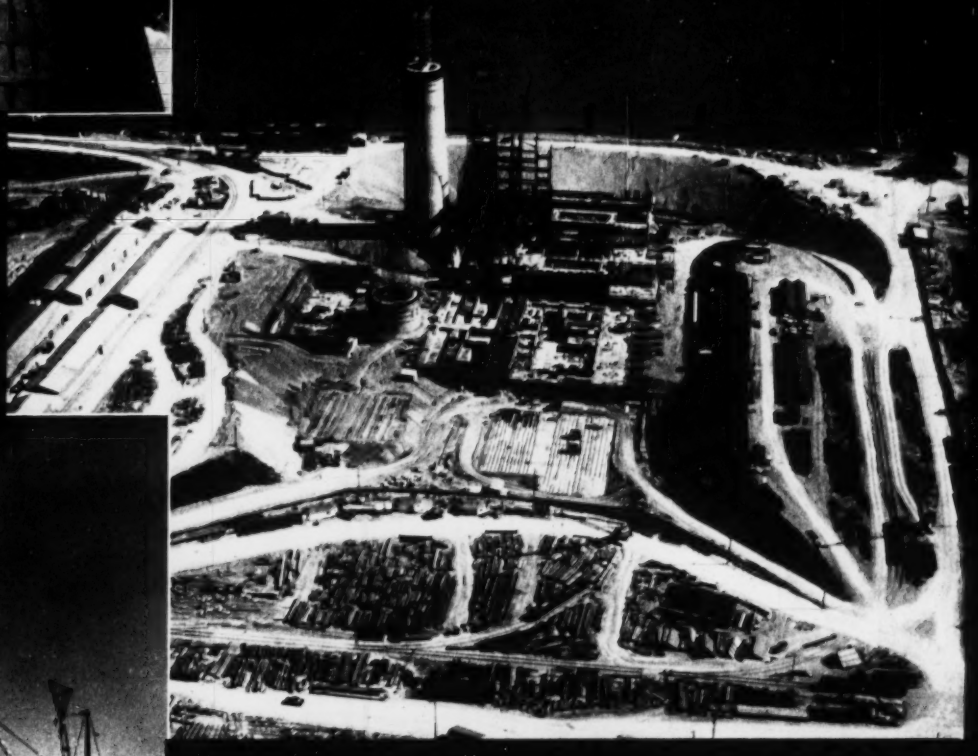
CIVIL ENGINEERING





POWER FOR AEC

Ohio Valley Electric Corporation builds two record-size steam plants for Atomic Energy Commission's Portsmouth, Ohio, Project. See article by Philip Sporn and H. A. Kammer.

Program • Hydraulics Division Meeting • Austin, Tex., Sept. 8-10

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NUMBER THREE OF A SERIES.

RAYMOND STANDARD PILE DRIVER

specialized equipment

FOR EVERY TYPE OF JOB!

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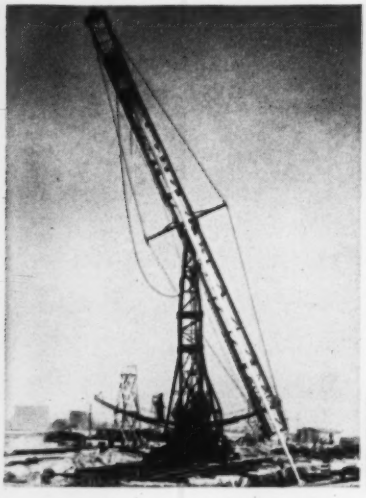

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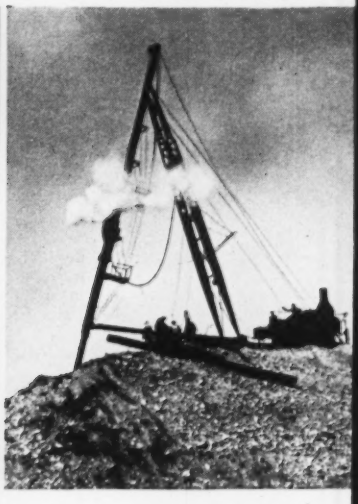

PROVIDE exactly the right type of equipment for each foundation job, Raymond has designed and built special equipment for every type of pile driving operation. This equipment is strategically located throughout the country and is available to start your work promptly.

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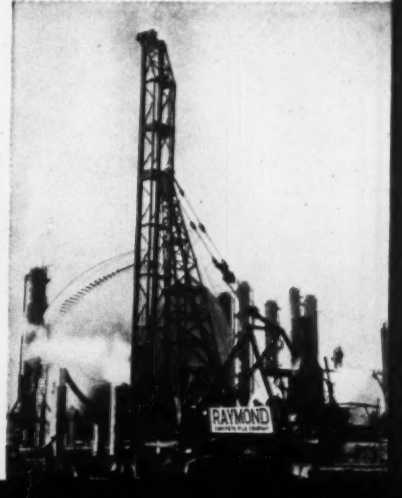

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RAYMOND'S DOMESTIC SERVICES . . . Soil Investigations • Foundation Construction • Harbor and Waterfront Improvements • Prestressed Concrete Construction • Cement-mortar Lining of Water, Oil and Gas Pipelines In Place.

RAYMOND'S SERVICES ABROAD . . . In addition to the above, all types of General Construction.

The new Senior High School Gymnasium at Greensboro, N. C. will have a playing floor 118 ft. square without obstructions. The reinforced concrete design with prestressed concrete girders saved the school district $10,000 over an alternate design calling for another structural material.

Owner:
GREENSBORO SCHOOL BOARD
Architect:
McMINN & NORFLEET,
Greensboro, N. C.
Consultant on Roof design:
THE FREYSSINET COMPANY,
New York City
General Contractor:
L. B. GALLIMORE CO.,
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Subcontractor for Prestressed Girders:
ARNOLD STONE COMPANY,
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Ready Mix Concrete:
F. D. LEWIS & SON,
Greensboro, N. C.

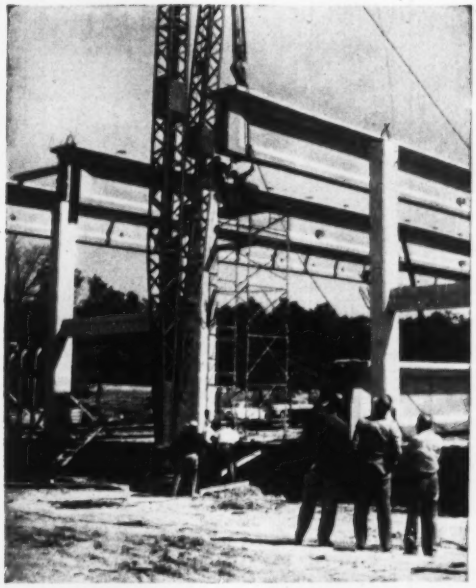
PRESTRESSED ROOF GIRDERS made with **LEHIGH EARLY STRENGTH CEMENT** SET NEW SPAN RECORD

The use of prestressed concrete continues to increase as architects and engineers design longer beams of less depth and weight. For example, the seven 120 ft. roof girders in Greensboro's new High School gymnasium are the longest prestressed concrete girders used to date in U. S. building construction.

Made with Lehigh Early Strength Cement, the girders reached the required prestressing strength of 4500 PSI in 6 days—just one half the usual time. This construction speed reduced labor and overhead costs . . . made it possible to go ahead with the rest of the job at an earlier date.

This is another of the many cases that causes us to say: "*Somewhere on nearly every job, Lehigh Early Strength Cement offers more convenience, more speed or lower costs.*"

LEHIGH PORTLAND CEMENT COMPANY
ALLENTOWN, PA.



Guy derricks were used to erect the girders which were then tied to their columns with tensioned cables. Lifting them took about 1½ minutes; setting the girders on their bearing plates took ten minutes more.

A single set of ⅛" thick plywood side forms were used for all seven girders. Only three sets of base forms were needed, because they could be easily removed for re-use when prestressing forces deflected the girders upward.

LEHIGH PORTLAND CEMENT • LEHIGH EARLY STRENGTH CEMENT • LEHIGH AIR-ENTRAINING CEMENTS • LEHIGH MORTAR CEMENT

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Most substantial and oldest design of grating made, permits perfect distribution of loads. Made on the truss principle, Borden Riveted Gratings are hydraulically power-forged for strength and durability. Particularly recommended for aluminum.

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CIVIL ENGINEERING

AUGUST 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• CONTENTS • VOLUME 24 • NUMBER 8

Duane R. Cady	33	**Difficulties overcome at St. Anthony Falls Lock and Dam**
E. J. McGrew, Jr.	37	**Performance-type building code gives scope for ingenuity**
	38	**AEC gaseous diffusion plant—Portsmouth, Ohio**
David J. Brumley	38	Pike County site prepared
Philip Sporn H. A. Kammer	44	Steam plants of Ohio Valley Electric Corporation furnish 2,200,000 kw
H. H. Nicholson	49	A million and a half high-strength bolts speed erection
John A. Dominy Charles C. Zollman Henon Pearce	53	**Fast precasting schedule for record-size Marine Corps warehouses**
	58	**EJC geared for fast action**
Gail A. Hathaway	62	**Water—a critical material**
Fred W. Blaisdell	65	**Borax solutions found to inhibit rusting**
John P. Cook	66	**New deformeter developed for structural model analysis**
	67	**PROGRAM of ASCE Hydraulics Division Meeting**

• SOCIETY NEWS

	71	**Junior Member program to be featured at Annual Convention**
	72	**ASCE-AGC stress employee rights in collective bargaining**
	73	**Tellers canvass ballot for 1955 ASCE officers**
	74	**EJC changes constitution**
	77	**Notes from the Local Sections**
Joseph H. Ehlers	79	**From the Nation's Capital**

• NEWS BRIEFS

80	**ASTM approves 65 new standards at Annual Meeting**
80	**AEC releases complete canned pump information**
81	**Half-year construction expenditures total record $16.6 billion**
82	**Need for engineers stressed at Annual Meeting of ASEE**
83	**Navy completes $20,000,000 jet plane center**
84	**Thin concrete shells studied at MIT Conference**
86	**Nuclear Notes**

• DEPARTMENTS

22	News of Engineers	98	New Publications
29	Non-ASCE Meetings	102	Positions Announced
31	Do You Know That	106	Men and Jobs Available
65	Engineer's Notebook	107	Applications for Admission
69	The Readers Write	110	Equipment, Materials and Methods
78	Scheduled ASCE Meetings		
88	N. G. Neare's Column	117	Literature Available
93	Deceased	124	Index to Advertisers
119	**Proceedings Papers available as Separates**		

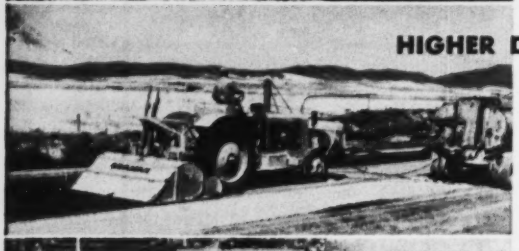
WHY YOU NEED A SEAMAN PULVI-MIXER FOR ALL YOUR MIXING....

CORRECTS AGGREGATE SEGREGATION

The unstable separation of coarse and fines *always* present when aggregates are transported, moved or pushed, is blended to absolute homogeneity. Coarse stone is keyed and inter-locked, voids are uniformly filled with fines.

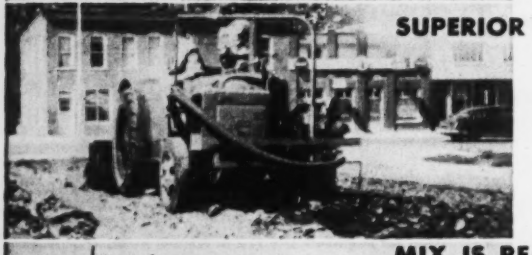
MORE THOROUGHLY AND MORE COMPLETELY MIXES ANY BINDER WITH ANY MATERIAL

Any fluid of any viscosity, any granular material from cement to rock salt is evenly blended and dispersed to full depth. No "lean" or rich spots in bituminous mixing. Checks fluid binder migration or water evaporation.



HIGHER DAILY OUTPUT AT THE LOWEST COST

Mixing a mile a day of 21 foot roadway is average in bituminous construction and soil-cement; and even more in chloride, lime, gravel or sand clay stabilization. One man operation.



SUPERIOR FOR RECONSTRUCTION OF OLD BASE

Simply scarify and shape to new grade old bituminous, gravel or sand clay base, use the PULVI-MIXER to pulverize and re-mix with new binder, added if needed.

MIX IS READY FOR IMMEDIATE COMPACTION

PULVI-MIXER holds the treatment to fine grade and crown previously established by the blades. Mix is level, smooth and partially compacted ready for rolling. No finish blading needed. Final compaction attains much higher density.

NEW BULLETIN completely describes SEAMAN Self-Propelled TRAV-L-PLANT and Self-Propelled PULVI-MIXER. Details processing information. Illustrates many field scenes. Send a postcard for Bulletin T.P.S.

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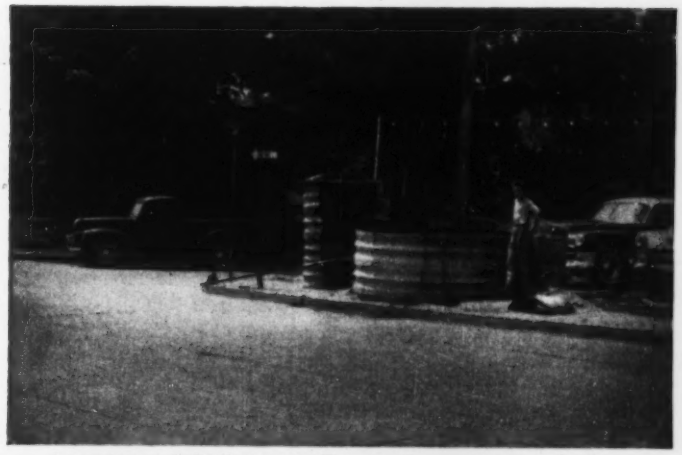
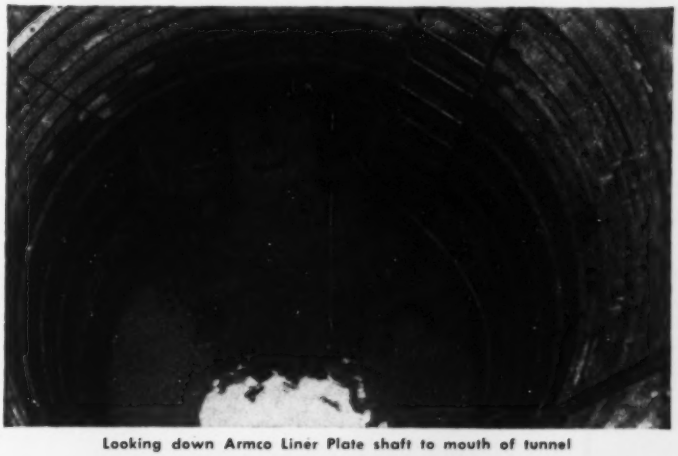
291 NORTH 25TH ST.
MILWAUKEE, WISCONSIN

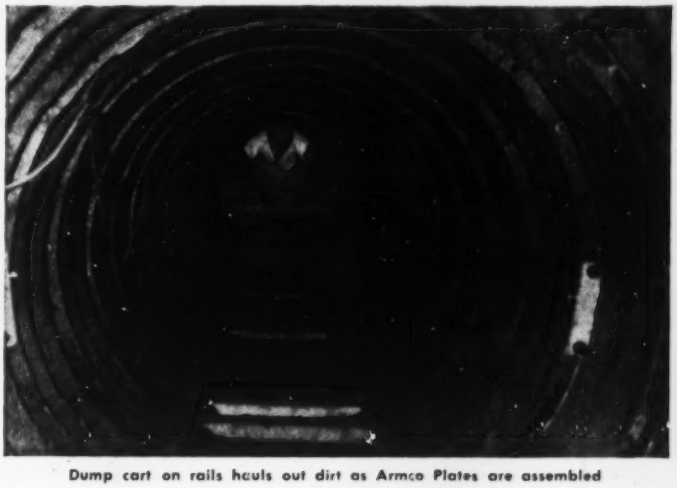
Tunnel helps clean-up job on Ohio River



Inconspicuous shaft eliminates traffic congestion and torn-up pavements



Looking down Armco Liner Plate shaft to mouth of tunnel



Dump cart on rails hauls out dirt as Armco Plates are assembled

Cooperating in the regional clean-up of the Ohio River, the city of Charleston, West Virginia, cut costs on a big intercepter sewer project by tunneling the job with Armco Liner Plates.

Sewage discharged into the Kanawha River will be processed through a sewage treatment plant that is part of the clean-up project. One of the first problems was that of installing intercepter sewers about 25 feet deep under two heavily traveled streets. Open cutting would have torn up sidewalks and pavements, disrupted traffic and business. Economy and convenience were prime considerations in tunneling with Armco Liner Plates. Tunnels were driven in both directions from shafts sunk every 400 feet. The tunnel required almost 4,000 feet of 12-gage, 48-inch diameter Armco Liner Plates. As the tunnel was completed the Armco Liner Plate used in the shafts was salvaged for reuse.

You, too, may benefit by using Armco Liner Plates as a solution to your own sewer problems. They are ideal for tunnels, shafts, caissons, conduits, underpasses, aggregate bins and for lining existing failing structures. Write for details. Armco Drainage & Metal Products, Inc., 1894 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO LINER PLATES

2,400-ft. shore line of protected with a tight wall of USS SHEET PILING

SITUATED at the apex of the famous Golden Triangle —where the Allegheny and Monongahela Rivers meet to form the Ohio River—the new Point State Park is part of Pittsburgh's vast redevelopment program.

One important phase of this project involved the construction of a river wall and wharf along 2,400 feet of shore line around the Park by the Contracting Division of Dravo Corporation.

Approximately 1,700 pieces (1066 tons) of MZ-27 interlocking USS Steel Sheet Piling ranging in length from 25 to 35 feet were driven to form the practically watertight, sandtight wall.

Employing the ball-and-socket type interlock, and having a uniform web and flange thickness of 3/8 inches, MZ-27 steel sheet piling sections are designed to afford high section modulus and long life at minimum weight.

Interlocking USS Steel Sheet Piling keeps earth and water in place permanently and economically

Assembled in easily driven units that positively interlock to the next, USS Steel Sheet Piling forms a wall that is sandtight and continuous and that can be made practically watertight. Because of its great strength, long life, low cost of installation and low maintenance cost, this versatile piling has proved invaluable in projects involving the retention and control of earth and water.

Available in straight web, arch-web, and "Z" sections, USS Steel Sheet Piling is a finished product as shipped, ready to be handled and driven under the most difficult conditions of soil, water or surf. An inquiry to the sales office nearest you will bring suggestions for any special problems you may have.

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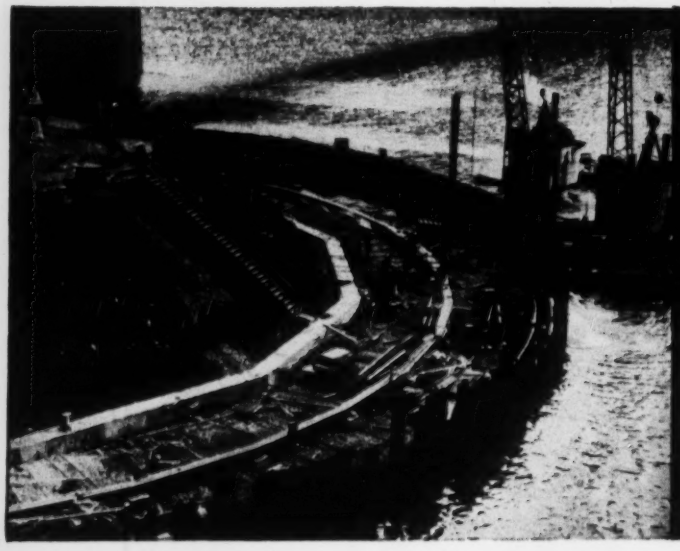
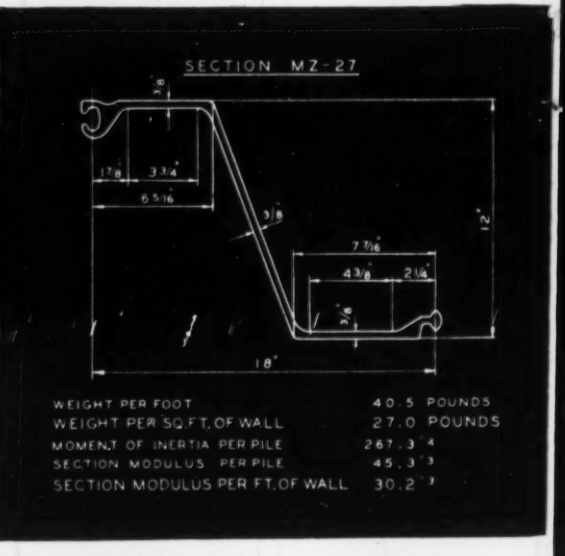
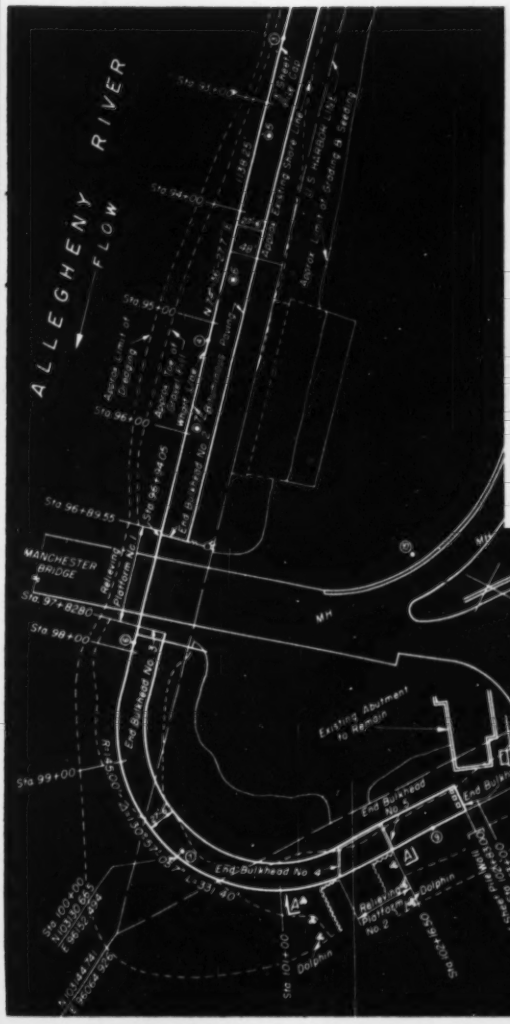




Pittsburgh's new Point Park



GENERAL PLAN OF
SHORELINE RETAINING WALL
Point State Park
Pittsburgh, Pa.

The
POINT STATE PARK
Pittsburgh, Pa.

OWNER
Commonwealth of Pennsylvania

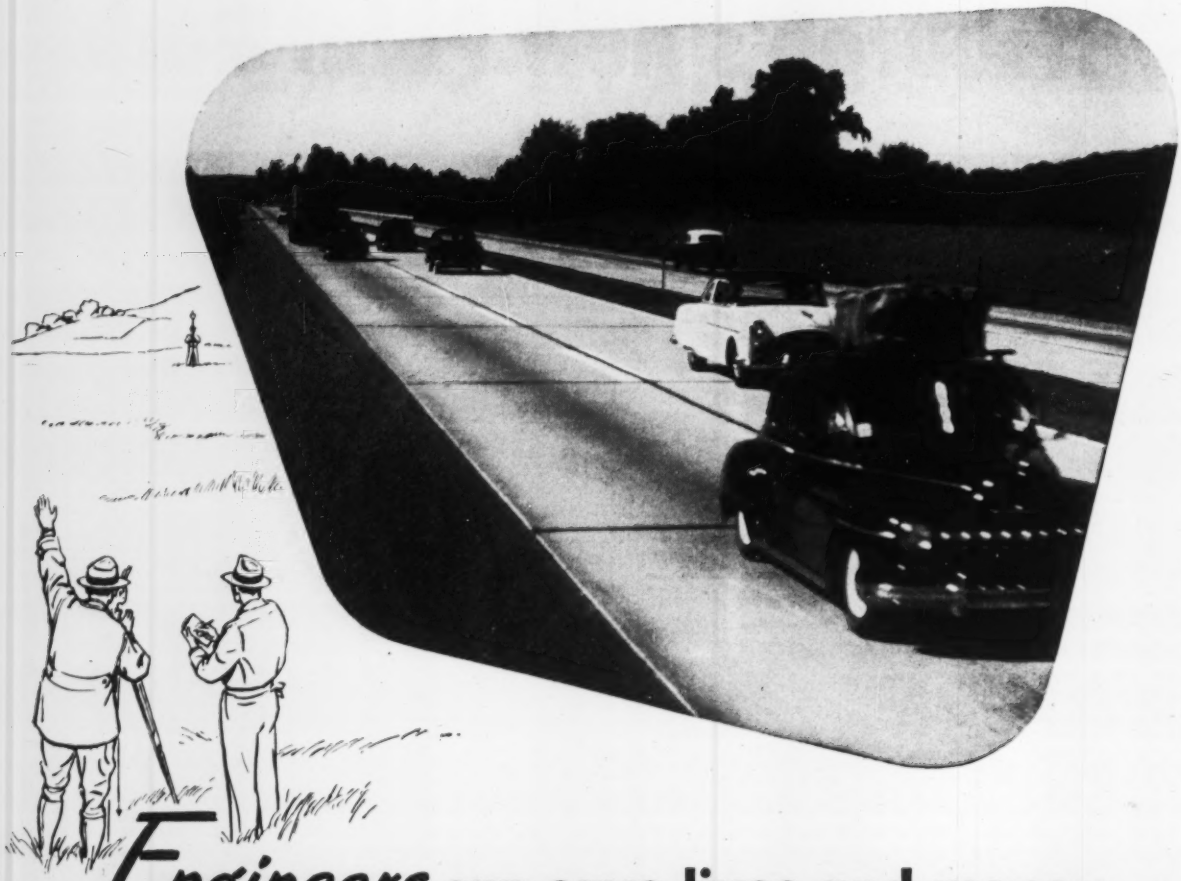
DESIGNERS
Ralph E. Griswold and Associates,
Landscape Architects

Clarke and Rapuano, Landscape
Architects and Engineers

CONTRACTOR
Dravo Corporation
Pittsburgh, Pa.

USS

UNITED STATES STEEL



Engineers can save lives and money by building main roads of Concrete

Everyone has a vital stake in America's main roads. Everything he eats, wears or uses comes wholly or partly over highways. His welfare and the nation's defense depends on an adequate system of main roads.

Most main roads are concrete.

Ninety-two per cent of the most heavily-traveled road sections in the U. S. is concrete. Some of this pavement has been resurfaced but it is the rigid concrete slab that still carries the load.

Nearly 80 per cent of the mileage on turnpikes and toll roads in America is concrete.

Main roads should be built of concrete. It is the safest, most economical pavement.

Concrete's light color reflects up to four times more light than dark pavement. You get maximum visibility at night. *If you can't see you can't be safe!*

Concrete's gritty surface texture is protection against dangerous skidding, even in wet weather.

Concrete is free from hazardous ruts, washboard ripples and raveled edges.

All these safety features of concrete pavement help reduce the tragic toll of highway accidents.

Concrete is moderate in first cost yet can be designed accurately for any axle load—and will *keep* that load-carrying capacity throughout its life.

Concrete has the lowest maintenance cost, according to official state highway department records.

Concrete lasts longer. Today engineers know how to build concrete roads to last 50 to 100 years.

Moderate first cost + low maintenance expense ÷ long life = ***low annual cost.*** Over the pavement's life that saves millions of dollars for taxpayers, who pay for building and maintaining roads with license fees, gas and other motor vehicle taxes.

Safety and economy. Two important reasons why all our main roads should be built of concrete.

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

BRINGING THE RECORD UP TO DATE

We Find That

ON THE NEW YORK THRUWAY
C. L. Guild Construction Co. has driven 720,213 Lin. Ft. of COBI PILES on 33 Contracts *(As of June 1, 1954)*

Here are seven reasons why you should specify and use COBI PILES

1. **COBI PILES drive straighter, due to the constant cross section of the heavy mandrel.**
2. **COBI PILES are more economical, they are driven in intimate contact with the soil and screw themselves into the ground.**
3. **COBI PILES are cast in forms that are water-tight. Every seam and splice is continuously welded.**
4. **COBI PILES maintain the original shape and form of the shells. They are driven as an integral part of the mandrel.**
5. **COBI PILES are largest where the need is greatest, down below.**
6. **COBI PILES show less settlement under heavy loads.**
7. **COBI PILES are anchored in the ground, they resist uplift best.**

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AMERICAN DRILLING COMPANY
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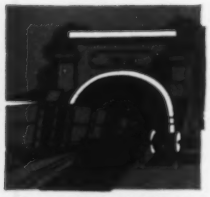

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our integrated operation means undivided control of quality

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FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

We are a wholly integrated pipe-producing unit — with mines, quarries, blast furnaces and laboratories under one direction and control.

What does this mean to you, a pipe buyer? It means that we are in the best possible position to take *complete* and undivided responsibility for the quality of our product . . . from raw materials to finished pipe.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to *our own* quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U. S. PIPE & FOUNDRY COMPANY

GENERAL OFFICES: BIRMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.

Laying the hot-mix Texaco Asphaltic Concrete wearing surface, final step in this New York State highway project. Prime contractor—Tuckahoe Construction Co., Tuckahoe, N.Y.; Asphalt contractor—County Asphalt, Inc., Tarrytown, N.Y.

New York made this an all-flexible highway

Applying an 85/100 penetration Texaco asphalt to the top 4 inches of the 12-inch broken stone base.

A section of the new 22-foot pavement, which will have a 10-foot shoulder on each side when completed.

West of Liberty, N. Y., State Route 52 serves one of New York State's most popular resort areas. Last year, when the Department of Public Works built a new 7-mile link in this highway, it employed flexible construction from top to bottom.

For the sub-base, run-of-bank gravel was laid in two lifts to a compacted thickness of 12 inches. This was covered by three 4-inch courses of broken stone, the top course penetrated by an application of two gallons of 85/100 penetration Texaco asphalt per square yard. A two-course hot-mix Texaco Asphaltic Concrete pavement, with a combined thickness of 3 inches, completed the highway.

The all-flexible type of construction used on New York's Route 52 merits serious consideration for all toll roads, important highways and other heavily traveled thoroughfares. It is capable of absorbing punishing impact for years with a minimum of maintenance. Its first cost and upkeep cost are lower than for comparable pavements. Its easy-riding, skid-resistant qualities, as well as its freedom from glare and absence of joints all contribute to maximum driving comfort and safety.

Helpful information on all types of Texaco asphalt construction for streets and highways is supplied in two booklets, which our nearest office will be glad to send you.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

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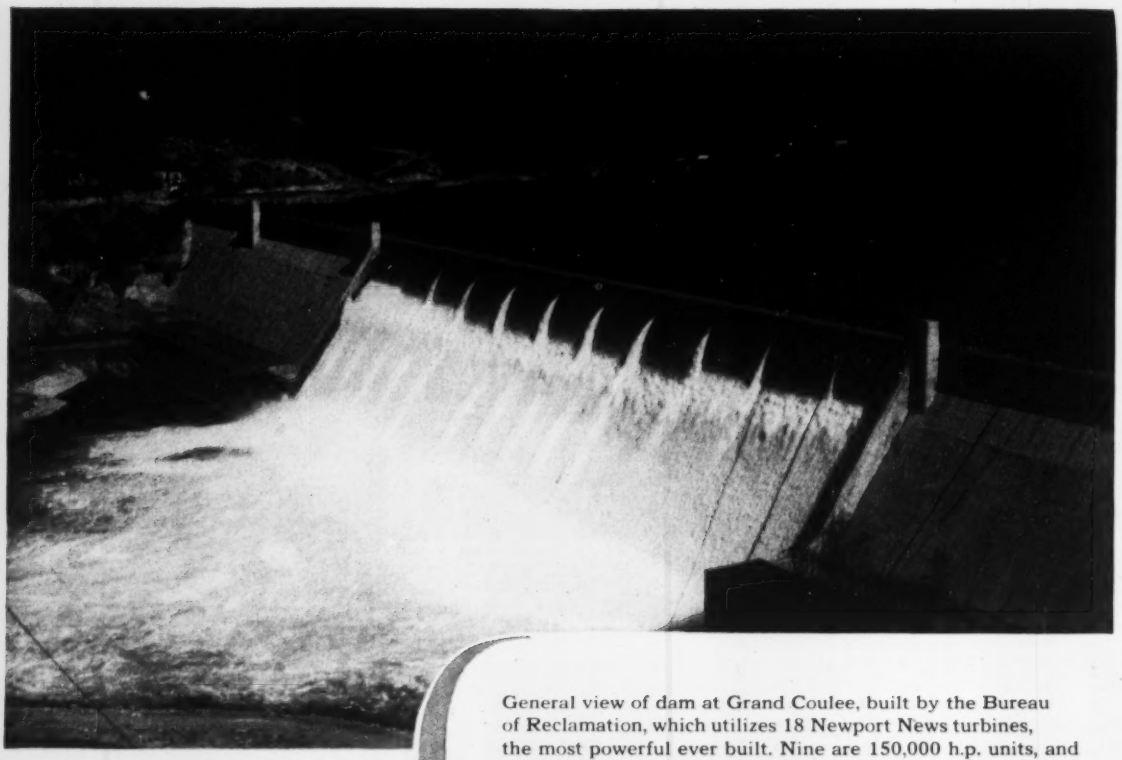
TEXACO

REG. T. M.

TEXACO ASPHALT



General view of dam at Grand Coulee, built by the Bureau of Reclamation, which utilizes 18 Newport News turbines, the most powerful ever built. Nine are 150,000 h.p. units, and the other nine are rated at 165,000 h.p. each.

Specialists ... in building Water Power Equipment

Typical Users of Newport News Equipment

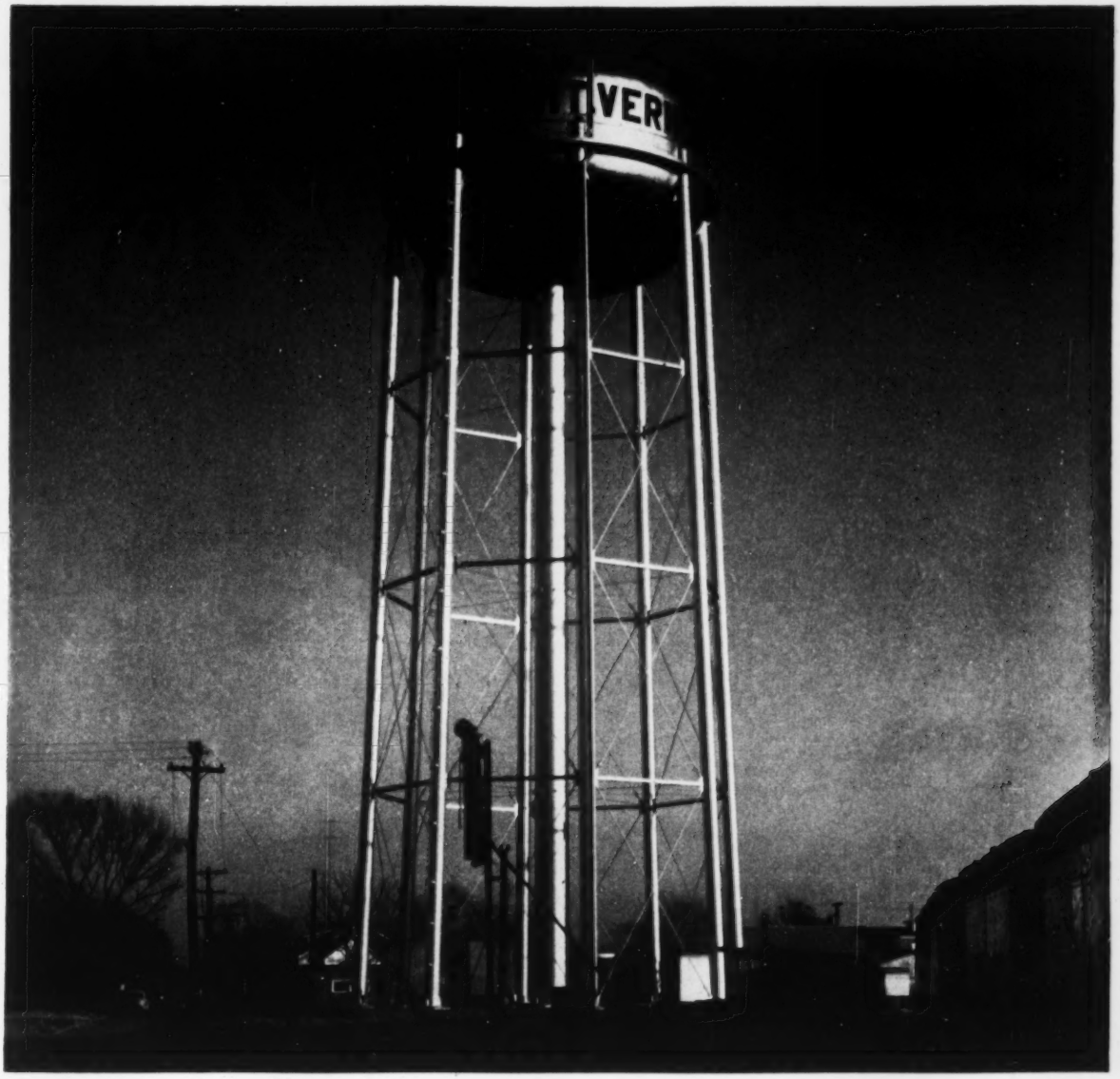
PLANT	LOCATION
Boone	Tennessee
Buchanan	Texas
Caonillas	Puerto Rico
Chief Joseph	Washington
Clark Hill	South Carolina
Deer Lake	Newfoundland
Folsom	California
Fort Patrick Henry	Tennessee
Hiwassee	Tennessee
Hoover	Nevada
J. H. Kerr	Virginia
Jim Woodruff	Florida
Lower Salmon	Idaho
Norris	Tennessee
Rock Creek	California
Santee-Cooper	South Carolina
C. J. Strike	Idaho
Whitney	Texas
Wilson	Alabama

Turbines designed and built for the world's largest development at Grand Coulee... and for other hydroelectric installations in America and various parts of the world... bespeak the skill and facilities offered by Newport News.

This trained organization has filled hydroelectric turbine contracts with an aggregate rated output of 7,000,000 horsepower.

Other equipment designed and built by Newport News includes penstocks, pressure regulators, valves, pumps, gates and rack rakes. Upon request, a copy of our illustrated booklet entitled "WATER POWER EQUIPMENT" will be sent to you.

Newport News
SHIPBUILDING AND DRY DOCK COMPANY
Newport News, Virginia



New Horton Elevated Tank Serves Mt. Vernon

The 500,000-gallon Horton® ellipsoidal-bottom elevated water tank shown above was recently built for Illinois Cities Water Company at Mount Vernon, Illinois. The structure is 137 feet to bottom and was pickled and painted by the Horton Pickling Process to provide a better bond between metal and paint—assuring maximum service life with minimum maintenance. Illinois Cities Water Company has other Horton elevated tanks in municipal water service at Palestine and Tuscola, Illinois.

Horton ellipsoidal-bottom elevated tanks are graceful, streamline structures of modern, welded steel construction. The columns, fabricated from steel plates, are hermetically sealed to keep out air and moisture; thus preventing corrosion on the inside. Butt welded construction results in smooth surfaces that can be painted easily, giving the steel lasting protection and long life. Horton ellipsoidal-bottom elevated tanks are built in standard capacities from 15,000 to 500,000 gallons. Where larger capacities are required, Horton elevated tanks are built with radial-cone bottom design in sizes to 3,000,000 gallons.

For estimates or quotations on Horton elevated steel tanks, write our nearest office stating capacity, height to bottom, range in head, location and shape or design desired.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2167 Healey Bldg.
Birmingham 1.....1596 N. Fiftieth St.
Boston 10.....1009—201 Devonshire St.
Chicago 4.....2199 McCormick Bldg.
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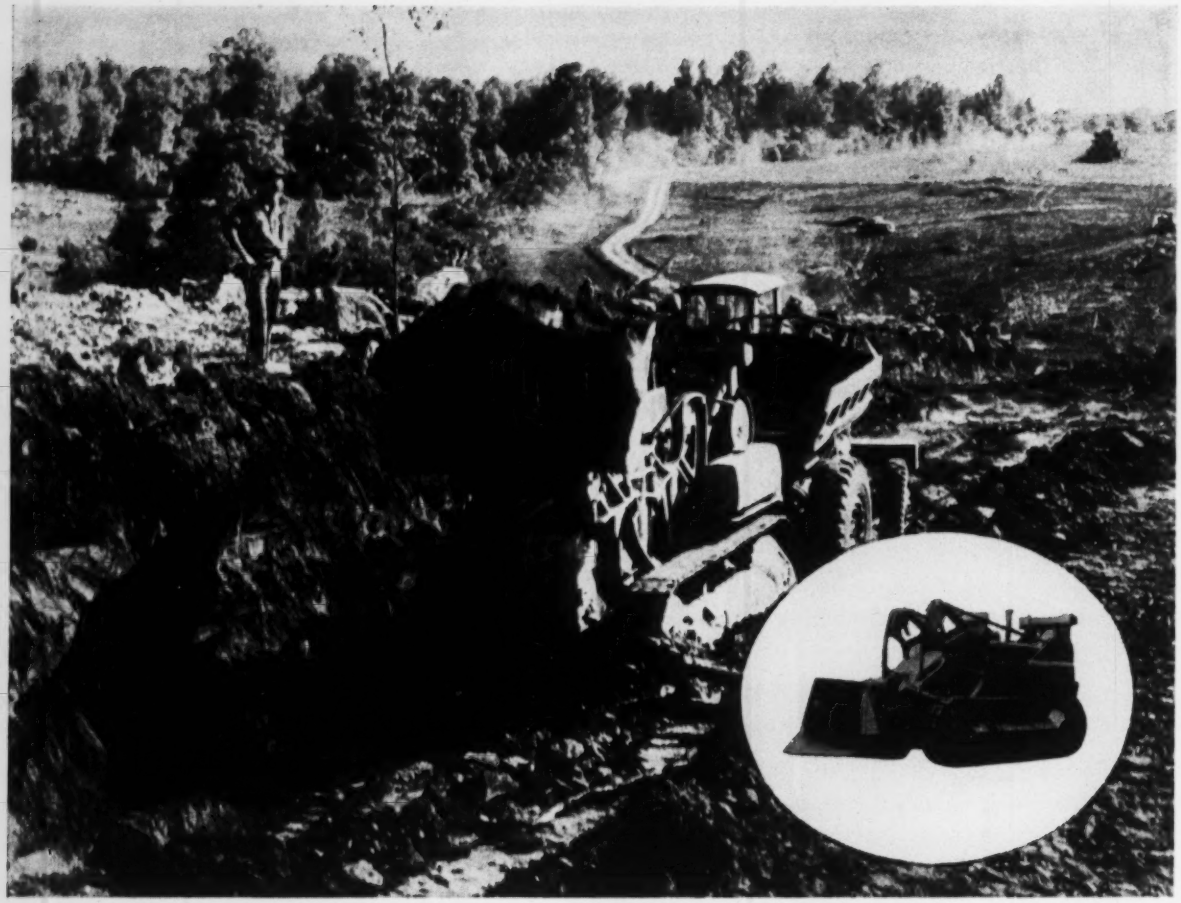
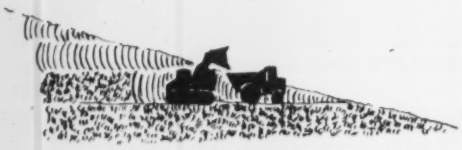
Houston 2.....2128 C & I Life Bldg.
Los Angeles 17.1556 General Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
Pittsburgh 19.....3210 Alcoa Bldg.
Salt Lake City 4.....509 West 17 South St.
San Francisco 4.....1584—200 Bush St.
Seattle 1.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.



TWICE THE PRODUCTION — FOR THE SAME $ INVESTMENT



The clay digging job shown in the picture and reported in the adjacent column is being excavated as shown in the sketch above. Successive cuts are taken at an average depth of 6-8 feet with 105's which provides fastest digging with no danger from undercutting.

Digging in clay without the benefit of preliminary ripping or drilling and shooting was the basis of the test between this Eimco 105 and an ordinary front end shovel loader of equal size and price.

Four trucks of the same size, design and manufacture were used. Two were assigned to each loader.

Results — the Eimco 105 could dig the hard clay easily and load quickly with an inexperienced operator at the controls. One day's production — 153 trucks with the Eimco waiting on trucks much of the time.

The ordinary shovel loader had difficulty digging, was slow to maneuver and loaded 75 trucks in the same time with trucks waiting to be loaded all the time.

This customer bought its second Eimco 105 a week after the first was on the job.

Eimcos deliver on all types of jobs and you can have — "Twice the production for the same $ investment" — when you use Eimco 105 tractors with loading attachments.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Texas Birmingham, Ala. Duluth, Minn. Kellogg, Ida. London, Eng. Paris, France Milan, Italy

B58

You Can't Beat An Eimco

North Carolina clay is hard digging, yet an Eimco 105 with an inexperienced operator loaded 153 trucks in its first 8 hour day on the job. A conventional front end loader in the same price category with the same bucket capacity and under identical conditions using an experienced operator was only able to load 75 trucks in the same length of time. You too, can get twice the production for the same capital outlay by buying an Eimco 105.

On the Waldo grade north of San Francisco an Eimco 105 is used in the tunnel to speed up mucking. As the top is broken out to make way for the huge steel supports muck runs down into the two pilot headings where only 15-20 minutes mucking time is required for approximately 75 yards per side. Fast, small trucks carry the muck out to stockpile where the same 105 loads into large trucks during drilling cycle.

Stockpile loading into trucks in Massachusetts. Eimco 105's load rock, sand, gravel, slag, brick, clay or any other material and two speed discharge makes it possible to fill large or small trucks. Independent track operation provides unlimited maneuverability, simple controls make handling easy. Write for more details to The Eimco Corporation, Salt Lake City, Utah.

8-69

BITUMULS® saves you money on maintenance

BITUMULS IS ASPHALTIC BINDER IN EMULSION FORM. Applied cold, it bonds well with every type of clean surface; it thoroughly coats all types of aggregates, wet or dry. It can be used in damp weather and even at relatively low temperatures. For the deep penetration required on trench repair (above), Bitumuls has no equal.

These features add up to real savings on any maintenance program: you save the time and expense of heating: you eliminate the need of a special prime or tack coat: you work with local aggregate of all kinds, lowering the expense of importing material: you save time lost due to showers: and you can start work-season earlier, keep going later in the year.

Bitumuls is available in grades for all types of maintenance work. Fast Setting for Sealing, Surface Treatment and for Penetration work; Mixing Grades for fast, uniform coating of a wide range of aggregates, from sand to clay-gravel.

There are Bitumuls Engineers who work out of offices near you. Call on them whenever you feel that they can assist on maintenance problems.

Ask for our new booklet, "BITUMULS FOR MAINTENANCE." It gives full technical information, with methods of application.

AMERICAN Bitumuls & Asphalt COMPANY

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WHETHER you're engineer, contractor or water works official, whether you're responsible for selection, installation or operation of water lines, here is a booklet that can show you the way to save money. It tells about the many outstanding features of the new Ring-Tite® Coupling; how water line assembly time is saved every step of the way; how it saves at valves, hydrants and fittings; how it pairs up with Transite® Pressure Pipe, the asbestos-cement product, that has set the pace for performance in water line service.

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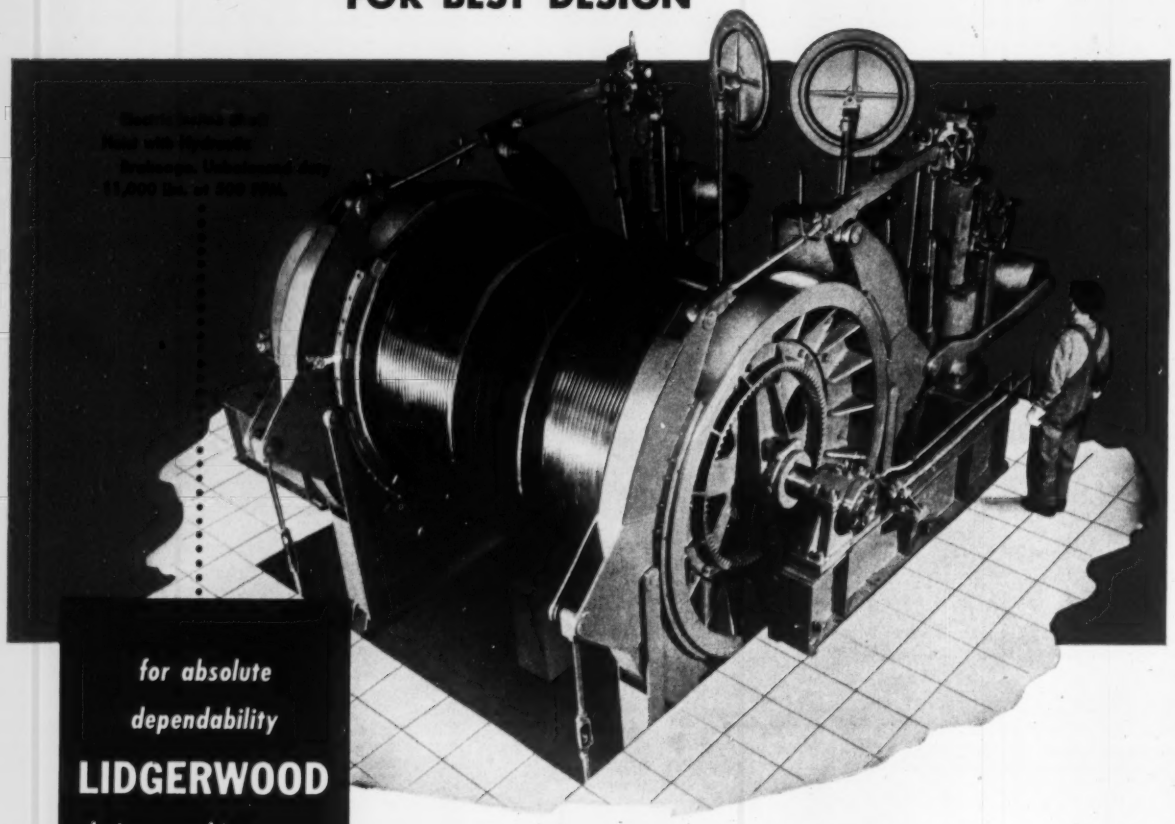
Johns-Manville TRANSITE PRESSURE PIPE

WITH NEW RING-TITE COUPLING

WHEN BUYING A *Hoist* REMEMBER...

BULK AND WEIGHT ARE NOT THE CRITERIA FOR BEST DESIGN



for absolute dependability

LIDGERWOOD

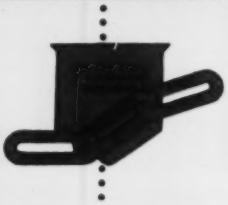
hoists combine more

STRENGTH
UTILITY
SAFETY

with less bulk and weight

● For over twenty years welded steel drums have been a feature of LIDGERWOOD design. Because of the consequent saving in bulk and weight, as compared with cast construction, the balance of the hoist can be made more compact and considerably lighter, with no sacrifice of strength, safety or utility.

WRITE FOR BULLETINS AND CATALOGS



Superior–Lidgerwood–Mundy Corporation

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NEW YORK OFFICE – 7 Dey St., New York 7, N. Y.

Norfolk Prefers Concrete Pressure Pipe

Since 1921, Norfolk, Virginia, has been specifying concrete pressure pipe for its water supply and distribution system. Over 450,000 feet of pipe is now in use. Diameters range from 20″ to 48″.

Still in excellent condition is the 31,700 feet of concrete pressure pipe laid in 1921. There has been no necessity to take this pipeline out of service for any maintenance work; nor has the pipeline suffered from any trouble due to electrolytic action. This pipe is now carrying water at the same high capacity as when it was installed.

If your city wants pipe with an assured high-carrying capacity, decade after decade . . . if long term economy is a necessity . . . then look into the advantages of concrete pressure pipe when you plan your next transmission or distribution lines.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

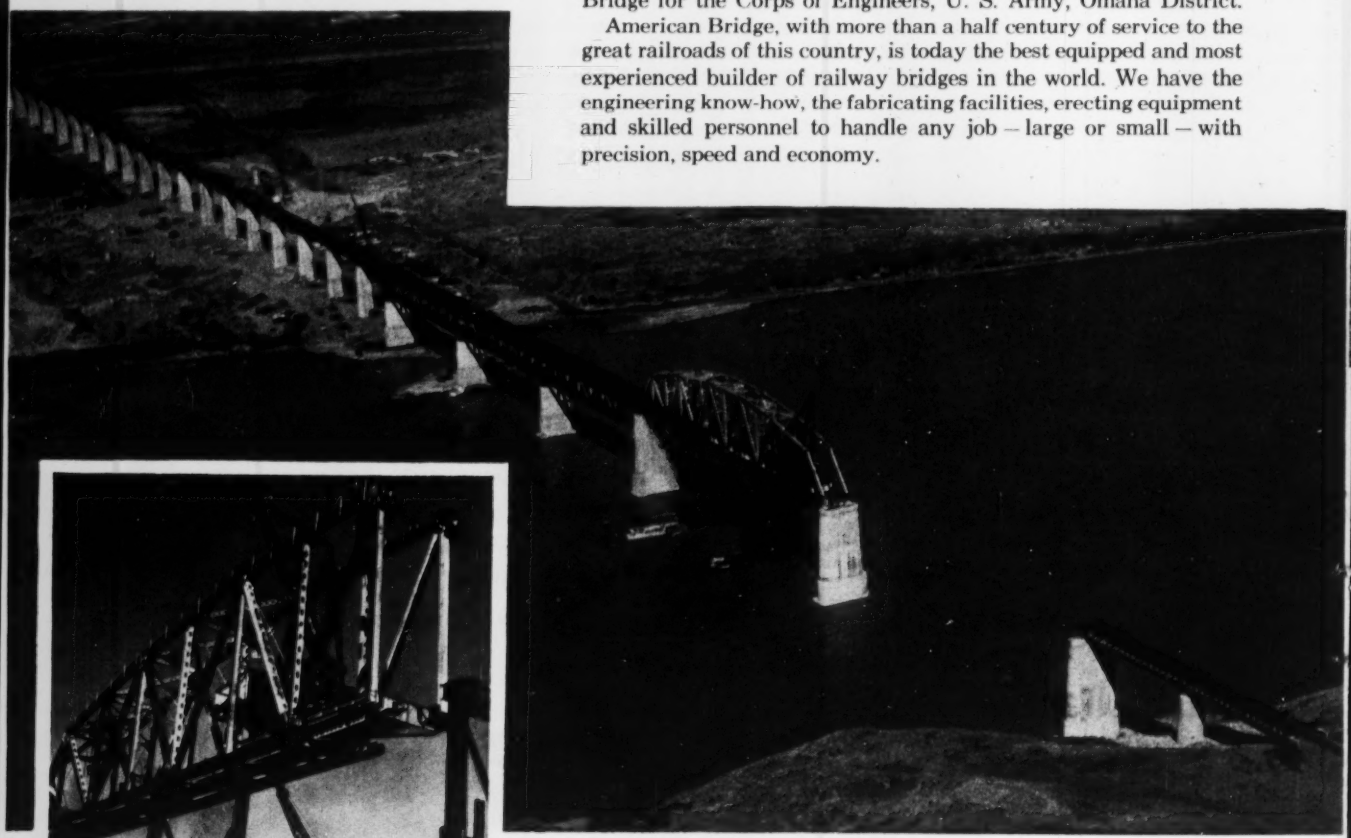
American Bridge builds 4,890-ft. bridge on CHICAGO MILWAUKEE ST. PAUL AND PACIFIC relocation project

New bridge over Missouri River has two 372-ft. through-truss spans.

THIS single track bridge over the Missouri River near Chamberlain, South Dakota, is part of the relocation of the C.M. St. P.&P. tracks made necessary by the construction of the Fort Randall Dam and Reservoir. It replaces the old bridge about 9,000-ft. upstream.

The 4,890-ft. structure features two 372-ft. through-truss spans over the main channel which provide a 42-ft. clearance above normal pool. The long bridge also has three 240′ deck truss spans, twenty-five 120′ deck plate girder spans, and four 98′ deck plate girder spans. Approximately 6,200 tons of structural steel went into the bridge, all of which was fabricated and erected by American Bridge for the Corps of Engineers, U. S. Army, Omaha District.

American Bridge, with more than a half century of service to the great railroads of this country, is today the best equipped and most experienced builder of railway bridges in the world. We have the engineering know-how, the fabricating facilities, erecting equipment and skilled personnel to handle any job — large or small — with precision, speed and economy.



Plans and specifications by Corps of Engineers, U. S. Army.
Fabricated and Erected by American Bridge.
Work performed under the direction of W. G. Powrie, Chief Engineer, C. M. St. P. & P. Railroad.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

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UNITED STATES STEEL

AMERICAN Cast Iron Pipe For River Crossings

RIVER CROSSINGS and other underwater pipe installations present no problems when you select AMERICAN river crossing pipe. Designed to meet the severe requirements of submarine pipe lines, AMERICAN Molox Ball Joint river crossing pipe provides for expansion and contraction of the pipe line and at the same time is locked against separation. The joint remains bottle-tight under pressures up to several hundred psi at any angle within the range of approximately 15° deflection it provides.

AMERICAN river crossing pipe's rugged construction enables it to be pulled across streams with cables or laid direct from a barge or bridge. The illustration shows parallel 30″ and 42″ AMERICAN Double-X Mechanical Locked Joint pipe lines combined with Molox Ball Joint double hubs, being laid under the Willamette River at Portland, Oregon. A balanced free-swinging four-point hitch was used to lay the pipe. The river depth ranged from 30 to 70 feet and the lines were each 1500 feet in length.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

AMERICAN Molox Ball Joint river crossing pipe is produced to national standard specifications in diameters 4″–30″ in 16-foot lengths. It is centrifugally cast with integral bell and can be furnished tar coated, Enamelined, cement lined, Lumnite cement lined or with other special linings. AMERICAN pipe with other types of joints is manufactured in diameters ranging from 2″–48″.

Whether it be underwater or overland, refer your next piping job to AMERICAN CAST IRON PIPE. Let us assist you by taking off lists of material and submitting prices on pipe and fittings—preferably when planning begins. Consulting with us imposes no obligation.

----MAIL COUPON FOR FREE CATALOG----

American Cast Iron Pipe Company,
Birmingham 2, Alabama

Gentlemen: Please send me a free copy of your catalog covering pipe for river crossings.

Name.....

Company.....

Street.....

City..... State.....

NEWS OF ENGINEERS

James Michalos, chairman of the department of civil engineering at Iowa State College, was recently named to a similar post in the New York University College of Engineering. Dr. Michalos replaces **Dr. Thomas C. Kavanagh,** who has resigned to work with the firm of Praeger and Kavanagh Engineers on a full-time basis.

Claree S. Mullen, chief engineer for the Virginia Department of Highways, Richmond, since the position was created in 1924, retired on July 1. **Archibald H. Bell,** location and design engineer for the department since 1930, retired on the same date.

Bruce B. Jacobs, formerly with the U.S. Atomic Energy Commission at Augusta, Ga., is now associated with the Rust Engineering Co., at Oak Ridge, Tenn. Another Rust employee, **Leo H. Kash,** has been transferred from the company's Pittsburgh office to Oak Ridge. He is acting as chief estimator in charge of industrial construction.

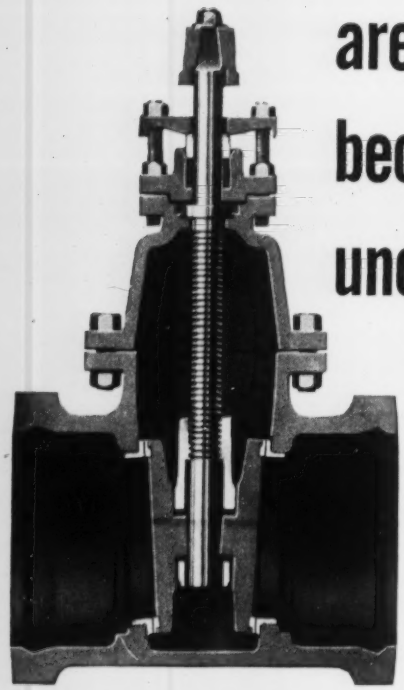
David Witheford, of Wilmington, Del., has been awarded a $2,000 Esso Safety Foundation Fellowship in the Yale Bureau of Highway Traffic for the coming academic year. A 1949 graduate of Swarthmore College, Mr. Witheford served in the Army for two years and has been employed by the Delaware State Highway Department.

Robert M. Dodds, member of the Pittsburgh engineering firm of Lorenzi, Dodds and Gunhill, has been named engineer for Baldwin, Pa. Mr. Dodds, a resident of Baldwin, has been a member of the Planning Commission of Baldwin Borough.

Robert P. White, since 1947 assistant superintendent of the Great Smoky Mountains National Park, has been promoted to engineer of the new Eastern Design and Construction Office of the National Park Service in Philadelphia. He has been working in the Smokies as a park engineer for more than 22 years.

William C. Ackermann resigned from the Tennessee Valley Authority early in May to accept a position as head of the newly formed Section of Watershed Hydrology of the Agricultural Research Service in Washington, D.C. **Alfred J. Cooper,** former head of the TVA's Procedures Development, has taken over Mr. Ackermann's duties as head of the Hydrology Section in the Hydraulic Data Branch.

R. D. Wood Gate Valves are reliable because they are uncomplicated



Available with mechanical joint connections.

There's a sort of reverse English to designing R. D. Wood Gate Valves. The point is to make them as simple as possible, to eliminate all the ingeniously complicated parts that look good in the blueprint but cause operating failures deep down in the lines. You'll appreciate their rugged simplicity when you put them to the test. R. D. Wood Gate Valves are built to function for generations of trouble-free flow control.

FEATURES OF THE R. D. WOOD GATE VALVE

Internal mechanism comprises only three parts—the spreader and two discs. Usual small wedges and delicate parts are avoided. Fully opened valve provides unobstructed passage for full pipe capacity.

Rising or descending, discs are free to revolve completely. In closing, discs are fully lowered before spreading action begins. Wear on bronze faces of discs and seats is evenly distributed.

R. D. WOOD COMPANY

Public Ledger Building
Independence Square, Phila. 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

ASCE President Daniel V. Terrell (right) is congratulated by Earl D. Dake, acting president of the South Dakota School of Mines and Technology, upon receiving the doctor of engineering degree at the June 4 commencement exercises. President Terrell, who is dean of the University of Kentucky's School of Engineering, presented an address on "The Engineer's Relations to World Population."

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Claude T. Wilson, real estate officer of the Colonial Trust Co., Waterbury, Conn., is also serving as president of the Connecticut Chapter of the American Institute of Real Estate Appraisers.

A. V. Karpov, New York consultant, is in Lahore, Pakistan, on his fourth United Nations' mission. He expects to return to New York in January 1955.

Thomas B. Kennedy recently assumed the duties of chief of the Concrete Division of the Waterways Experiment Station, at Vicksburg. A member of the Corps of Engineers since 1931, Mr. Kennedy has been serving as chief of the Division's Concrete Branch since 1949. He is a member of the Soil Mechanics and Foundations Division's Task Committee on Portland Cement Grouting.

Le Roy H. Cather recently became a partner in the New York engineering firm of De Leuw and Brill—now known as De Leuw, Cather & Brill.

James E. Dunn, manager of the Portland Cement Association office in Washington, D.C., has been promoted to district engineer of the newly-opened Orlando (Fla.) branch.

Harold Fidler, manager of the San Francisco Area Office of the Atomic Energy Commission, has become manager of the Operations Office as a result of recent reorganization. Beginning in July, the reconstituted San Francisco Area Office will act as an Operations Office reporting directly to the Washington headquarters.

E. M. Killough, of Baltimore, Md., retired on July 1 as valuation engineer for the Western Maryland Railway Co.

Richard G. Kimbell has been appointed to the newly-created post of vice-president of technical services for the National Lumber Manufacturers Association, in Washington, D.C. An authority on building codes and wood utilization, Mr. Kimbell has been with the association for 35 years—for the past 20 as director of the technical and standards department. A second promotion announced by the organization is that of **John G. Shope,** who has advanced from architectural engineer to director of building codes.

Vincent De Paul Lukas has been named sanitary engineer for the General Electric Co., at Schenectady, N.Y. He was previously employed as a sanitary engineer with the Water Pollution Control Section of the New York State Health Department, Albany.

Harry A. Balke, Cincinnati consultant, announces a change of firm name and ad-

(*Continued on page 24*)

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COMPASS
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it's handy for
PRELIMINARY AND SUPPLEMENTARY SURVEYING

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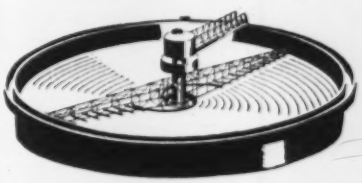
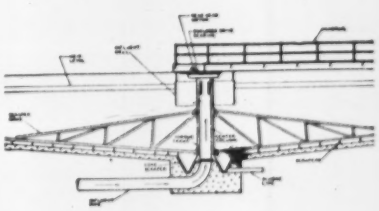


Center-Feed
Center-Discharge
Clarifiers



One reason for the efficiency of Hardinge Clarifiers is the fact that the influent goes directly to a central stilling well and the underflow also is centrally removed. This promotes quick disposal of the heavier solids immediately upon entry—makes less work for the rotating sludge scrapers. The clear effluent overflows the tank periphery, where velocity is at a minimum. Bulletin 35-C-37.

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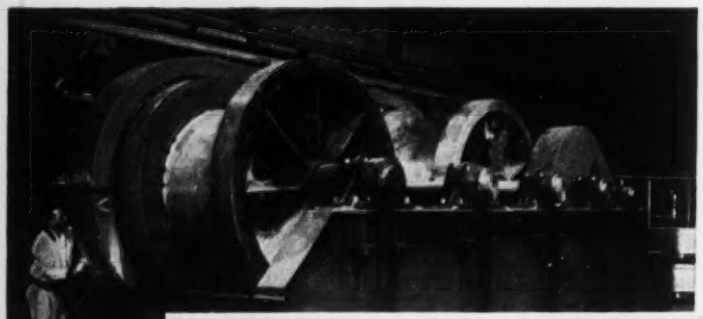


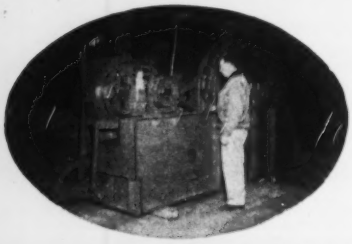
Typifies Machinery We Can Build to Your Order

This YUBA-built double-drum dredge hoist is designed to handle 194-foot digging ladder and is capable of lifting 800 to 1000 tons. Single-drum hoist (bottom) built by YUBA for tramway carries 5200 feet of wire rope. We're old hands at building such machinery. Every bucket ladder dredge Yuba has built combines many special "machines"—hoists, conveyors, drives, screening and metal saving equipment, winches, pumps —all designed and built by Yuba.

Experience and Facilities

YUBA's manufacturing experience includes grooved drums for large gate hoists, barges, steel and chemical plant equipment, construction rigs, clamshell buckets, ordnance, other custom work, and structural steel production. Parts for field assembly are fitted and match-marked before shipment to insure accuracy.

Our facilities include shops for carbon and alloy steel forging, heat treating, steel fabricating, welding, pattern work, iron and bronze castings, and machine shop capable of handling single large, heavy pieces. We have long experience in properly preparing and documenting export shipments.



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65

News of Engineers

(*Continued from page 23*)

dress. Headquarters for his organization —now known as Harry Balke Engineers— will be 2330 Victory Parkway, Cincinnati, Ohio, and 104 South Bennett St., Urbana, Ill.

J. Wright Taussig, senior vice-president and a director of the Raymond Concrete Pile Co., retired as vice-president on June 30 after nearly 46 years of service. Mr. Taussig joined the company immediately after graduating from Cornell University. Since 1926 he has devoted his time to sales, the supervision of design, specifications and contract negotiations. Mr. Taussig has been a director of the Metropolitan Section and chairman of the Construction Division's Committee on the Bearing Value of Pile Foundations.

J. Wright Taussig

Philip L. Bailey has been promoted from area to district engineer in the Los Angeles office of the Asphalt Institute. His former position has been filled by **Louis R. Hovater,** until recently head of the civil engineering department for Donald R. Warren Co., architects and engineers of Los Angeles.

Richard H. Norair, formerly with the Norair Engineering Corp., Washington, D.C., is now employed by the U.S. Air Force at Tullahoma, Tenn.

Estep T. Gott retired on July 1 from the directorate of the Dravo Corp., Pittsburgh, after a 48-year association with the firm. Mr. Gott was for some years vice-president and director of the contracting division of the organization.

Col. H. R. Hallock, for the past two years head of the Fort Worth District of the Corps of Engineers, is now attending the Army War College at Carlisle Barracks, Pa.

Robert K. Palmer, assistant professor in the department of civil engineering at Rensselaer Polytechnic Institute, has been advanced to the rank of associate professor.

C. A. VanWinkle is now managing the Gun-Crete Co., of Louisville, Ky. Previously Mr. VanWinkle was a structural engineer for the Girdier Corp., of Louisville.

Harold D. Hauf, director of public and professional relations for the American

Institute of Architects has been appointed professor and head of the department of architecture at Rensselaer Polytechnic Institute. Professor Hauf previously taught at Yale University for 20 years and was chairman of the department of architecture there for three years.

R. E. Hickson, who recently retired from the Corps of Engineers after 48 years of service, is now engaged in consulting work, specializing in river and harbor, lock and dam, dredging, and flood control design and construction. He is located at 525 S.E. 65th Ave., Portland, Oreg.

Allen Wagner has been appointed director of public information for the American Transit Association, New York, N.Y. In recent months, Mr. Wagner has been director of public relations for the National Jewish Hospital in Denver, Colo.

Maxwell R. Warden, president of the Remington Arms Co., Inc., Bridgeport, Conn., has been elected a member of the board of directors of the Bridgeport City Trust Co.

William H. Ivy is now employed as reports engineer at the TVA Gallatin Steam Plant after serving for two years in the Army.

Sergio Cuevas resigned on June 30 as executive director of the Puerto Rico Aqueduct and Sewer Authority due to ill health. Mr. Cuevas, who has held the post since the Authority began operation nine years ago, will continue to serve in an advisory capacity. He will be succeeded by **Rafael V. Urrutia.**

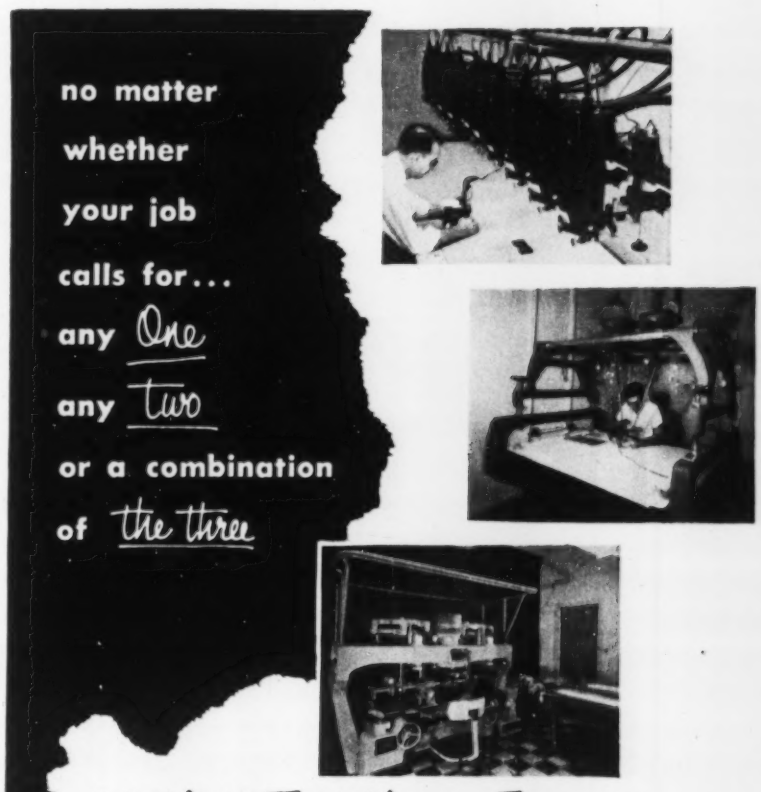
Lucius D. Barrows, chief engineer of the Maine State Highway Commission, Augusta, received the honorary degree of doctor of engineering from the University of Maine at its commencement exercises on June 20.

LeRoy Crandall, Fredrick Barnes and **Leopold Hirschfeldt** have formed the consulting firm of LeRoy Crandall & Associates, with headquarters at 1614 Beverly Boulevard, Los Angeles, Calif. The firm will specialize in foundation engineering.

Charles I. Mansur was recently promoted from chief of the Design and Analytical Section of the Soils Division at the Waterways Experiment Station, to assistant chief of the Embankment and Foundation Branch. Mr. Mansur is a member of the Committee on Seepage and Drainage of the Earth Dams Committee of the Society's Soil Mechanics and Foundations Division.

Francis T. Bradley, of Australia, received the degree of master of science in petroleum production engineering from Tulsa University during the past commencement season.

(*Continued on page 27*)



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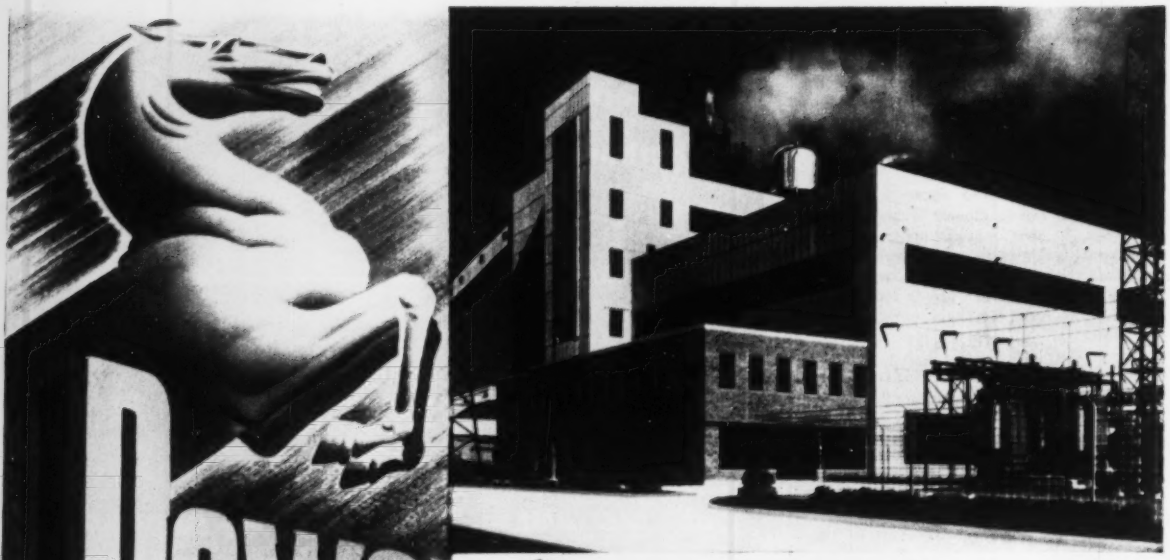

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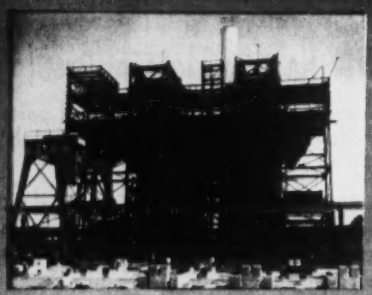
Power to spare



Lumberton, N. C.—Power Plant, Carolina Power & Light Company

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News of Engineers

(*Continued from page 25*)

George Leonard Sullivan, since 1918 dean of the college of engineering at the University of Santa Clara, has been elected to honorary membership in the American Society of Mechanical Engineers. Dean Sullivan is a member of both ASCE and ASME.

John O. Bickel, Rush F. Ziegenfelder and **William H. Bruce, Jr.,** have been named partners in the consulting firm of Parsons, Brinckerhoff, Hall & Macdonald, effective July 1. The three men have been with the firm for several years—Mr. Bickel as engineering manager of the New York office; Mr. Ziegenfelder as executive manager of the San Francisco branch; and Mr. Bruce as head of the Trenton, N.J. office.

Victor L. Streeter will assume the position of professor of hydraulic engineering in the department of civil engineering of the University of Michigan, for the fall semester. At the time of his appointment he was professor and director of fundamental fluids research at the Illinois Institute of Technology and consultant in mechanics to Armour Research Foundation.

Michael C. Hinderlider, Colorado state engineer at Denver, retired in July after serving in that capacity for 30 years.

William T. Hogg has been promoted from assistant to chief engineer of the Port of New Orleans Board of Commissioners. **Col. Marcel Garsaud,** acting chief engineer since January, will remain with the engineering department in an advisory capacity.

Alfred C. Ingersoll, assistant professor of civil engineering at the California Institute of Technology, has been appointed under the Point Four Program as a specialist in engineering fluid mechanics at the Bengal Engineering College in India. He is scheduled to leave for his new post on August 5.

Henry T. Perez has been named editor of *Construction Methods and Equipment,* succeeding the late **Harold W. Richardson.** For the past three years Mr. Perez has been senior associate editor of CM & E, and was previously on the staff of *Engineering News-Record.*

Edward J. Squire, head of the civil engineering department of the Brooklyn Polytechnic Institute, has been awarded two international honors—the Order of Scientific Merit of the Humanist Institute of France and the Knight Commander with Star of the Order of the Gold Cross of the Military Chapter of Cyprus and Jerusalem.

Lewis McDonald, vice-president and assistant to the chairman of the board of the Chicago Bridge & Iron Co., retired on June 30 after more than 44 years.

Frank C. Mirgain, head of the civil engineering department at the Cooper Union, New York City, has been appointed dean of engineering at North Dakota Agricultural College at Fargo. From 1933 to 1949 Professor Mirgain taught at Rutgers University. He is a former president of the New Jersey Society of Professional Engineers and secretary of the Society's Metropolitan Section.

Frank C. Mirgain

Nicholas A. Rose, consulting groundwater geologist, announces the removal of his office to Suite 3B, 2419 Fannin, Houston 2, Tex.

Charles A. McMahon received the degree of civil engineer from the University of Colorado at the June graduation exercises. Mr. McMahon is a project superintendent on construction of the Anheuser-Busch Brewery in the San Fernando Valley.

Louis J. Rumaggi, brigadier general, U.S. Corps of Engineers, and engineer officer at Headquarters Army Field Forces, Fort Monroe, Va., has been reassigned to

(*Continued on page 28*)

PLASTIMENT* CONCRETE DENSIFIER

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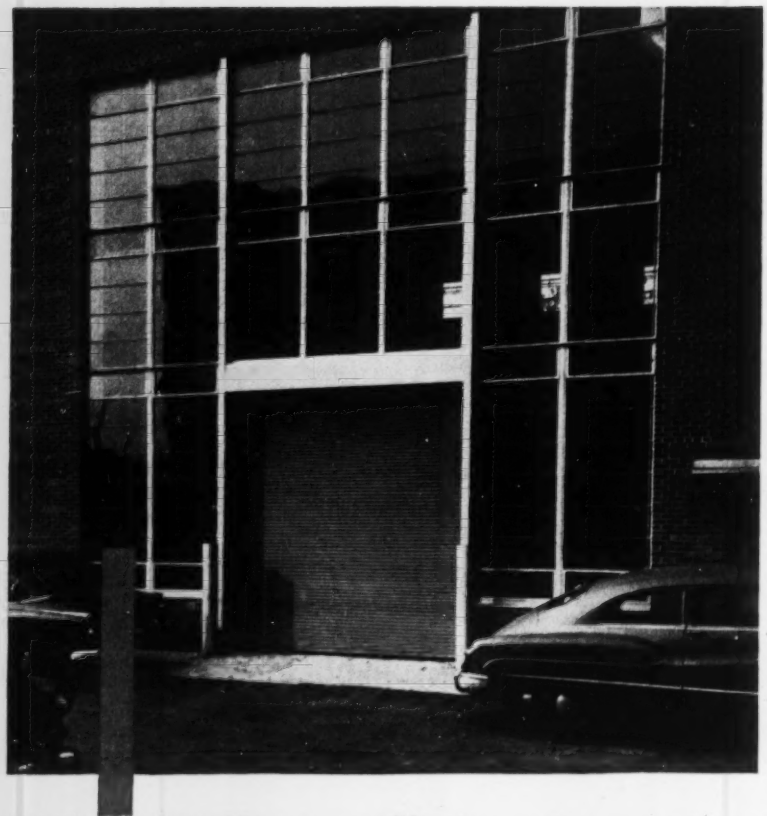

"Glass Wall" Installation Dramatizes Advantages of Kinnear Rolling Doors

Light from a huge "glass wall" floods into the new engineering building at Howard University, Washington, D.C., shown above.

The Kinnear Rolling Door centered in this glass wall can be operated or left open without blocking off a single inch of glass area.

The rugged curtain of interlocking steel slats — originated by Kinnear — coils compactly above the opening. All surrounding floor, wall and ceiling space remains clear and usable *all the time.*

Notice also how the straight lines of the Kinnear curtain add to the modern appeal of this building.

In addition to this space-saving "self-contained action", Kinnear Steel Rolling Doors offer durable, low cost, all-metal protection against intruders, vandals, wind, weather, and fire.

Kinnear Rolling Doors are built in any size, with manual or motor operation. Write for full details.

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SAVING WAYS with DOORWAYS
KINNEAR ROLLING DOORS

News of Engineers

(*Continued from page 27*)

Washington, D.C., as deputy chief of engineers for military operations.

Sam Ruvkun recently returned from a five-week trip as a member of an eight-man team surveying Finland's industries for the International Bank for Reconstruction and Development. Mr. Ruvkun was on leave from his position as project engineer with the Kaiser Engineers Division of the Henry J. Kaiser Co., Oakland, Calif.

Albert P. Boysen, division engineer of the American Bridge Division of the United States Steel Co., and **George L. Jackson,** chief engineer of the State of Illinois Toll Highway Commission, have been installed as first and second vice-presidents of the Western Society of Engineers. Named to a three-year term as trustee is **John P. Gnaedinger,** president of Soil Testing Services Inc., Chicago.

Orville W. Chinn, since 1949 director of the Kentucky Division of Flood Control and Water Usage, with headquarters at Frankfort, was recently appointed director of the state's new Strip Mining and Reclamation Commission.

Victor F. B. de Mello, of Saõ Paulo, Brazil, has been appointed professor of soil mechanics and foundation engineering in the Faculty of Architecture and Urbanism of the Saõ Paulo University. Professor de Mello is also on the staff of the School of Engineering and the Faculty of Architecture at Mackenzie University, and is director of works for Geotécnica, S.A., consulting engineers of Saõ Paulo and Rio de Janeiro.

Charles T. West, who has been serving as acting chairman of the department of mechanics at the college of engineering, Ohio State University, has been appointed professor and permanent chairman of the department.

Billings Wilson, who retired on July 31 as director of operations and tunnels and bridges for the Port of New York Authority, was honored by ten commissioners and 32 members of the Port Authority at a dinner at the Savoy Plaza Hotel. Tribute was paid to "his unfailing loyalty, devotion and ability."

George L. Beard recently resigned as chief of the planning and development division of the Corps of Engineers, in Washington, D.C., to join the Pacific Power Co., Portland, Oreg.

E. L. Warner recently retired as manager of the Harrison Pipe Co., Tacoma, Wash., after twenty years in that capacity. Mr. Warner is planning to organize an engineering firm after he has had a long vacation.

Non-ASCE Meetings

American Institute of Chemical Engineers. Meeting at the Colorado Hotel, Glenwood Springs, Colo., September 12–16.

American Institute of Electrical Engineers. Fall General Meeting at the Morrison Hotel, Chicago, Ill., October 11–15.

American Institute of Steel Construction. Thirty-second annual convention at the Greenbrier, White Sulphur Springs, W. Va., October 25–28. Further information from the American Institute of Steel Construction, 101 Park Ave., New York, N.Y.

American Public Works Association. Public Works Congress and Equipment Show at the Municipal Auditorium, Atlantic City, N.J., September 19–22. Contact the American Public Works Association, 1313 East 60th St., Chicago 37, Ill., for more detailed information.

Federation of Sewage and Industrial Wastes Associations. The twenty-seventh annual meeting will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, October 11–14. Requests for hotel accommodations should be sent directly to the hotel.

Fifth Alaska Science Conference. Fifth annual meeting at Anchorage, Alaska, September 7–10.

Society of Automotive Engineers. National West Coast Meeting at the Hotel Statler, Los Angeles, Calif., August 16–18. Write to the SAE at 29 West 39th St., New York, N.Y., or the SAE Western Branch Office, 714 West Olympic Boulevard, Los Angeles 15, Calif.

Society for Experimental Stress Analysis. Annual meeting and exhibition to be held in conjunction with the First International Instrument Congress & Exposition at the Bellevue-Stratford Hotel, Philadelphia, Pa., September 21–23. Further information regarding this meeting may be obtained from the General Chairman Frank G. Tatnall, P.O. Box 4034, Chestnut Hill, Philadelphia 18, Pa., or Exhibits Chairman Greer Ellis, c/o Ellis Associates, P.O. Box 77, Pelham 65, N.Y.

Southeastern Association of State Highway Officials. Annual meeting at the Andrew Jackson Hotel, Nashville, Tenn., September 28–30.

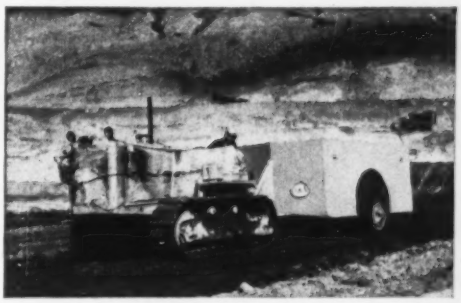
UPADI. The third convention of the Pan American Federation of Engineering Societies (UPADI) will meet at Saõ Paulo, August 2–12. Write to EJC, 29 West 39th St., New York, N.Y., for more detailed information.

World Power Conference. Sectional meeting will be held in Rio de Janeiro, July 25–August 10. Detailed information is available through EJC, 29 West 39th St., New York, N.Y

BROS tip sheet

EQUIPMENT NEWS FROM A FAMOUS NAME IN ROAD MACHINERY

HERE'S HOW ROLL-O-PACTOR* CONTINUES TO REVOLUTIONIZE "BIG JOB" COMPACTION



Patented Bros design equalizes weight distribution over all four wheels on roughest terrain. "Superload" compaction! Roll-O-Pactor* is backed by the entire Bros factory and distributor service organization.

You spread earth in 18" lifts instead of 6" lifts, and use a 50-ton Bros Roll-O-Pactor* to compact to greater density with fewer passes. You break the slow compaction bottleneck, and rain doesn't keep you off the job as long as it does with other compaction equipment. Government and private job studies have proved beyond question the value of this Roll-O-Pactor* that others are trying to copy, even under possible patent infringements.

*Bros Roll-O-Pactor is patented in U.S.A., Canada and Mexico.

TWO NEW TAMPER FOOT DESIGNS NOW OFFERED BY BROS

Illustrated at right are the new Bros standard diamond-shaped tamping roller foot and the replaceable "Tamprite" foot. Both of these foot designs are now available on giant Bros "G" Series tamping rollers. Ft. psi range of the "G" series is 260 lbs. to 738 lbs.

Bros cleaner teeth are new, too. They have adjustable and reversible blades which mean that blades last longer and drums stay cleaner because blade contact can be readily adjusted.

Above left is the new Bros diamond-shaped foot with "relief" shank for easier withdrawal from soil. At right is the "Tamprite" foot with removable tip which saves time on replacement and readjustment, and lengthens foot life.

"Quickies" for your information

Since you don't want to be caught with "orphan" compaction equipment, remember that Bros is the world's largest manufacturer of pneumatic tire rollers.

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Smaller Bros rubber-tire rollers are 7, 9 and 13-ton models.

Only Bros offers the widely tested and approved "Wobble-Wheel" design so popular on our smaller pneumatic tire rollers.

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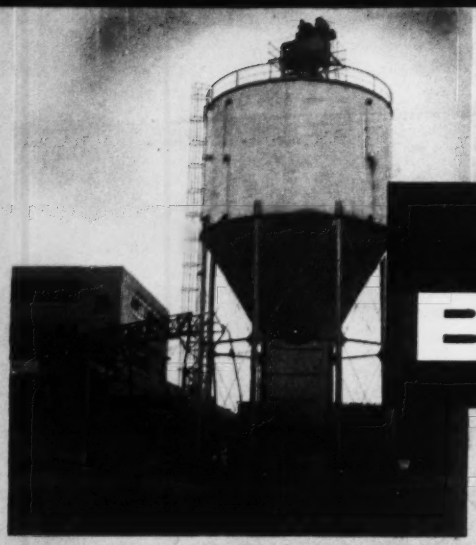
- ☐ Special Airborne Roll-O-Pactors*
- ☐ Bros 7, 9 and 13-ton Pneumatic Tire Rollers
- ☐ Giant weight Bros "G" Series Tamping Rollers
- ☐ Medium weight Bros Series "M" Tamping Rollers
- ☐ Bros smooth drum rollers



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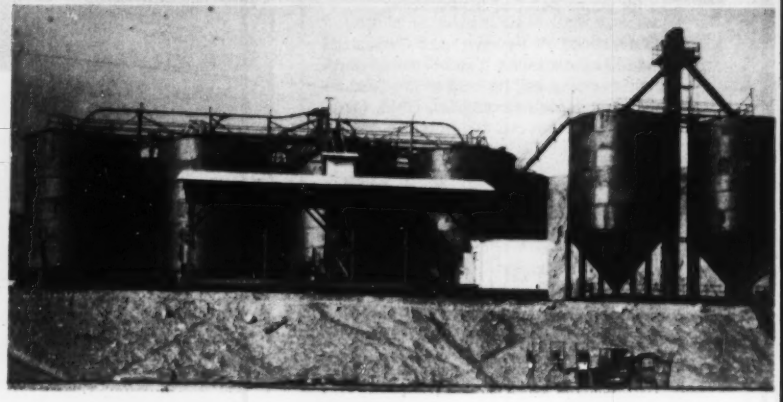

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do you know that

EJC has changed its constitution? The eight constituent EJC societies recently approved changes in its constitution providing for associate and affiliate society membership in addition to the present type of participation. A proposal to admit individuals to membership was tabled for the time being. Details on page 74.

Thin concrete shells are being used for some of the most impressive structures being built today? At a three-day conference on thin concrete shells, held at MIT in June, it was established that properly designed shells develop stresses so low that ordinary concrete and semi-skilled workmen can be used to build them. Typical photos are shown on pages 84 and 85.

A construction total of $36 billion is forecast for 1954? With construction expenditures for the first half of the year at $16.6 billion, the Departments of Commerce and Labor look for a 2 percent increase over the 1953 record construction total of $35.3. Their analyses are on pages 81 and 83.

New Society officers have been nominated? The tellers' report on the balloting for new Directors and Vice-Presidents appears on page 73.

Power for the AEC's gaseous diffusion plant at Portsmouth will be supplied by the largest single power contract in electric utility history? Some of the problems involved in furnishing 15 billion kwhr per year are discussed on page 44 by officials of the Ohio Valley Electric Corp., a group of private utility companies formed to handle the $400,000,000 project.

A million and a half high-strength bolts have been used on a 100,000-ton building project? Successful use of high-strength bolts to speed up steel erection on the Portsmouth plant of the Atomic Energy Commission is reported on page 49 by H. H. Nicholson, M. ASCE, general superintendent of the Operations Unit for the contractor on the job.

Precast, prestressed concrete beams are now being fabricated to order in New York by Precrete Inc.? The plant, which is equipped to deliver beams and girders of any design, is currently supplying prestressed members for a new Port of New York Authority marginal wharf being constructed at the Lincoln Tunnel site.

A vehicular tunnel is to be built under the St. Lawrence at Quebec? Construction of a two-mile, four-lane tunnel between Quebec and the south shore of the river, long considered an engineering impossibility, will begin this summer, with completion scheduled for early in 1957. The tunnel is a private venture of Tunnel Champlain, Inc., a concern set up for the purpose of building the crossing at a profit. Engineers are the Wallace G. Rouse Co., of Port Chester, N.Y., and Muchmore Associates, of Stamford, Conn.

President Eisenhower has proposed a $50 billion road program? A huge ten-year program for modernizing the nation's highway system, to be undertaken jointly by the federal and state governments, is being urged by the President.

The Mississippi may be reduced to a trickle? Unless remedial measures are taken, says the Army Corps of Engineers, the Atchafalaya River will steal the Mississippi's flow sometime in the next twenty years, leaving such lower river ports as New Orleans high and dry. The remedial measures proposed by the Corps are giant sluice gates that would regulate flow into the Atchafalaya.

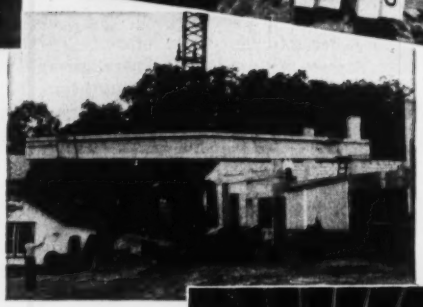
Several new pieces of Society jewelry have been made available in the past year? Members wishing to order one of the various Society emblems available will find an order blank in the May issue (p. 119).

A sound national water policy is urgently needed? ASCE Past-President Gail A. Hathaway reviews the critical water situation in an article in this issue (page 62) and urges the active cooperation of individuals, industry, and all levels of government to achieve such a policy.

Interesting new Society meetings are coming up? There is word of the Annual Convention on page 71, and of the Hydraulics Division meeting in Texas on page 67, and the Irrigation and Drainage Conference in Salt Lake on page 75.

Hoover Dam, now highest in the world, will soon be topped by two Swiss dams? The dams being built in Switzerland are the Mauvoisin, 745 ft high, and the Grand Dixence, 912 ft high. Hoover Dam is 726 ft high. See PROCEEDINGS SEPARATE No. 355, R. A. Sutherland.

Prefabrication COMES OF AGE!



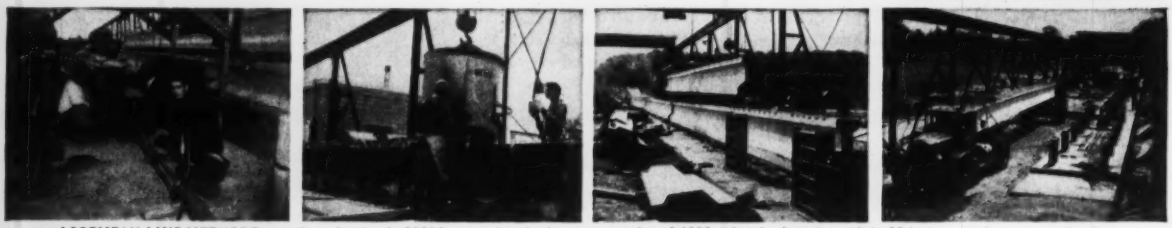
218 Precast, Prestressed Deck Girders, with Spans up to 63', Factory-made for Garden State Parkway Bridges

● Precasting continues its rapid spread, as today's building costs intensify the quest for sound economies. The range of concrete prefabrication is greatly widened by prestressing, which makes possible lighter members and longer spans, for buildings and bridges, with substantial savings in concrete and steel. Prestressing is really pre-testing, because a member is subjected to greater loads in fabrication than it takes in the field.

Factory-made, prestressed deck girders, 218 in number, up to 63 ft. in length, for eight bridges on New Jersey's Garden State Parkway, highlight this trend. Designed by GANNETT FLEMING CORDDRY & CARPENTER, INC., Harrisburg, Pa. and manufactured by FORMIGLI ARCHITECTURAL STONE CO., Williamstown Junction, N. J., every member is field practical, for fast erection with minimum supervision.

Cost in place invites comparison . . . inherent resistance to fire, weather, rust and rot, with no painting and little or no maintenance, mean further economies . . . marking the coming of age of concrete prefabrication.

For school and residential, commercial and industrial construction, factory-made concrete columns, spandrel beams, girders, roof slabs, provide fire-safety, structural stability and pleasing appearance of concrete, at marked cost advantage.



ASSEMBLY-LINE METHODS speed production in 320'-long pretensioning bench at Formigli's Williamstown Jct., N. J. plant, where 5 bridge deck girders were cast at a time and steam-cured. Facia members were post-tensioned at Formigli's Berlin, N. J. plant. 'INCOR'* 24-HOUR CEMENT produced 4000 psi stripping strength in 18 hours, setting tempo of operation, assuring maximum output at minimum production cost . . . with high ultimate strength and durability, hallmarks of America's FIRST high early strength portland cement. *Reg. U.S. Pat. Off.

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CIVIL ENGINEERING

AUGUST 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Upper lock and lower lock and dam at St. Anthony Falls have been superimposed on air view. Minneapolis & Western Railroad bridge just above lower dam has now been removed. Downtown Minneapolis is at upper left.

FIG. 1. Limits of project and location of existing structures are shown on map of Mississippi River where it passes through Minneapolis.

ST. ANTHONY FALLS DAM AND LOCK

Foundation difficulties and high water overcome

DUANE R. CADY

Civil Engineer
Peter Kiewit Sons' Company
Omaha, Nebr.

To the dismay of many civic leaders and businessmen, Minneapolis has never been able to utilize the Mississippi River as a major artery of transportation. At present, most of the shipping coming into the Twin Cities is handled by docking facilities at St. Paul and along the Minnesota River—which enters the Mississippi from the west just below Minneapolis. The St. Anthony Falls on the Mississippi (Fig. 1) prevents barge traffic from moving into the heart of the city's industrial district. Below the falls, the high bluffs on each side of the river make any expansion of present docking facilities impossible. The Minneapolis Barge Terminal, situated under the Washington Avenue bridge, with no chance for expansion, can handle only a small part of the shipping destined for Minneapolis. However, the river banks above the falls provide excellent sites for wharfage facilities. Thus a navigable channel into this reach would mean tremendous savings in transportation costs.

In 1937 Congress authorized the Army Corps of Engineers to start plans for a system of locks through the falls. This project, known as the "Upper Minneapolis Harbor Development," includes: (1) dredging the channel to a 9-ft depth from the limits of the existing channel at the Northern Pacific Railroad bridge to a point 4.6 miles upstream; (2) construction of a lower lock and dam; (3) con-

←

Model at University of Minnesota Hydraulic Laboratory, built on scale of 1:50, provided valuable information on current flow which was used as basis for design of project structures.

→

Cofferdam for Stages 2 and 3 has just been closed. Inner wall of sheetpiling was driven around this cofferdam, as around Stage 1 cofferdam, to reduce seepage through sandstone. Dam upstream from cofferdam will be removed. At right can be seen Piers 1 and 2 of dam, previously constructed in Stage 1 inside first cofferdam, which was overtopped three times by flood waters.

struction of an upper lock; (4) alteration of seven existing bridges; and (5) provision of a turning basin approximately 500 ft wide and 1,000 ft long just downstream from the Lowry Avenue bridge.

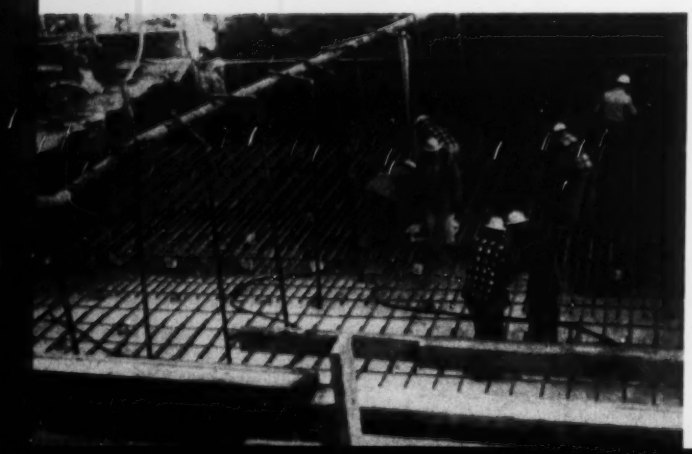
Because of the geologic formations, the engineering problems involved proved very complex. The area around the falls consists of an underlying layer of Platteville limestone which is 25 ft thick five miles downstream and feathers out just above the falls. This limestone rests on a deep stratum of St. Peter sandstone and a thin layer of impervious siltstone imbedded within the sandstone stratum. The St. Peter sandstone, a soft friable rock composed of uniform quartz spheres with slight cementation, provides little resistance to erosion by water. On the other hand, the Platteville limestone above it erodes at a much slower rate. The combination of these two formations resulted in the falls as they exist today. The erosion of the sandstone undercut the limestone ledge, causing it to break off periodically, so that until about 1860 the falls were receding up the river at the rate of 18 in. per year. At that time a series of dams was built across the falls to prevent their eventual disintegration into a series of rapids.

Since all foundation structures must be set on the sandstone, the Army Engineers made careful studies of this formation. Numerous borings were made at the lock and dam sites, and Dr. G. M. Schwartz of the University of Minnesota prepared a complete geological report on the rock formations at the falls. It was found that the sandstone provides an excellent foundation for structures so long as it remains in its undisturbed state, but that, when subjected to erosion by moving water, it disintegrates rapidly.

The Corps of Engineers made an intensive study of the hydraulic problems, which included model studies at the University of Minnesota Hydraulic Laboratory. A model built on a scale of 1:50 provided a basis for the lock and dam design. The model simulated river conditions between the Northern Pacific Railway bridge and the Hennepin Avenue bridge. By this method, design engineers studied current conditions and determined the most desirable location for the locks and piers. They also made model studies of the spillway and submergible Tainter gates to determine the proper shape of crest, the still profile, and the length of apron for the lower dam. From other models, designers worked out the details for emptying and filling the locks.

For the lower lock (and the upper one also), the U.S. Corps of Engineers decided on a dry-dock type of construction. In designing the lock, they considered its floor as a beam resting on an elastic foundation with the side walls as cantilever beams. Barring cracks in the concrete, a design of this type eliminates the possibility of water seeping from the lock chamber into the sandstone foundation. Since the lock rests directly on the sandstone instead of on piling, any leak in the lock floor would result in serious undermining of the foundations. Copper sheeting set in the contraction joints prevents any leakage through these joints (Fig. 2).

The lock has miter gates on the downstream end and a Tainter gate on the upstream end. The use of a Tainter gate at the upstream end permits flood flows to be passed through the lock. The elevation of the top of the lower dam is more or less fixed by the numerous facilities which line the bank. Any excessive lowering of the dam would inter-



In some parts of foundation for lower lock and dam, well points had to be used inside forms and pumped until concrete had set. Piping was then cut. Care was needed to avoid driving well points through impervious siltstone because of artesian pressures below.

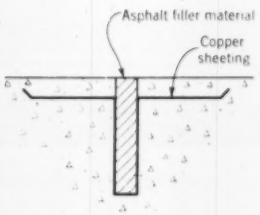
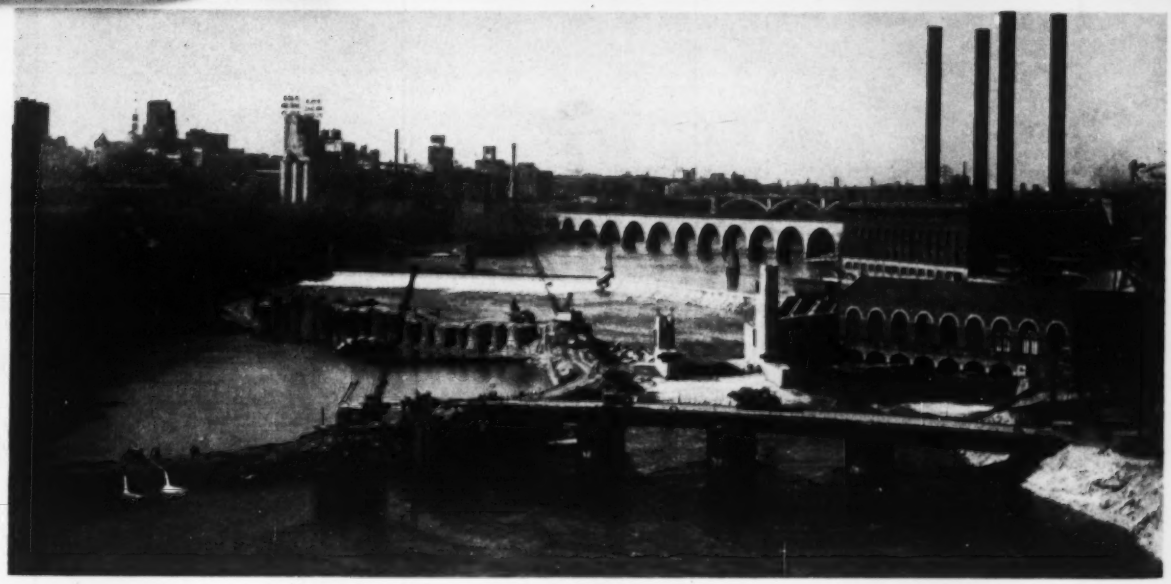


FIG. 2. Typical contraction joint in lock floor and wall consists of slot filled with asphalt filler material and outlined with copper sheeting.



fere with the cooling-water intake line and draft tubes of the St. Anthony Falls Water Power Company. The lock Tainter gate is 20.5 ft high and 56 ft wide, exactly like the Tainter gate in the auxiliary lock bay and the three Tainter gates in the dam proper. A fixed electric hoist, mounted on the service bridge, will control the gates in the lock and dam.

Designers worked out a new system for emptying and filling the locks. Other locks on the Mississippi, with intake ports located in the walls, tend to slap the barges around considerably during filling. At these new locks therefore, to minimize turbulence, the intake and discharge ports are placed in the floor. The intake system consists of a 12-ft conduit, located in the landward side of the lock wall, which feeds the subfloor outlet ports. The lock is emptied through the same system. Two valves, one at the downstream end and the other at the upstream end, control the flow in and out of the lock. Both upper and lower lock chambers are 56 × 400 ft. The vertical lift of the lower lock is 25 ft, and that of the upper lock is planned to be 49 ft—the highest on the Mississippi. The landward wall of the lower lock is 33 ft thick at the base which includes the 12-ft intake conduit, and the channel wall is 15 ft thick.

The dam, at the lower lock, is of gravity type with relief pipes in the foundation to prevent excessive uplift pressures. A shear key on the upstream face projects 15 ft below the base of the dam (Fig. 3). In addition to the three Tainter gates in the dam proper and the Tainter gate in the auxiliary lock bay, the dam includes 230 ft of non-overflow section on the left side of the river. Under normal conditions, the three Tainter gates in the dam proper will pass all the flow, but the gate in the auxiliary lock bay and that in the lock itself will assist in passing high flows. The total height of the dam, from the top of the pier parapets to the bottom of the shear key, will be 112 ft.

A timber-mat filter bed placed downstream of the overflow section will prevent any undermining of the sandstone. This bed will consist of lumber and gravel with a top layer of derrick stone. Derrick stone will also be placed on the channel bottom adjacent to the upstream face of the dam.

Because of the alignment of the existing upper dam and the skewed position of the Great Northern Railroad bridge piers, a training wall will extend 1,100 ft downstream from the base of the upper lock to insure proper flow into the lower dam.

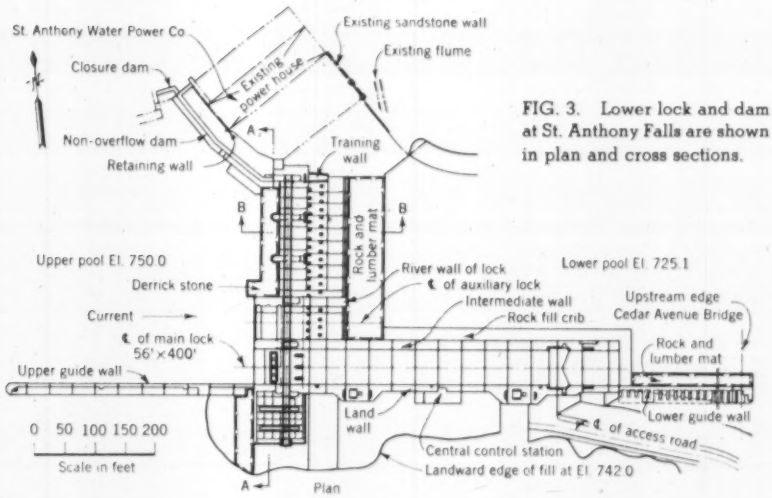
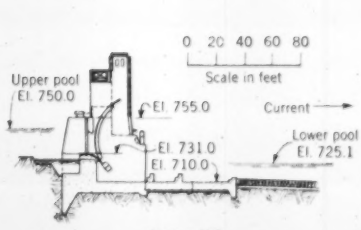
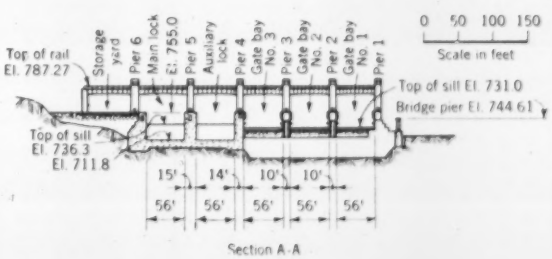


FIG. 3. Lower lock and dam at St. Anthony Falls are shown in plan and cross sections.



Section B-B



Section A-A

The Corps of Engineers in the St. Paul District designs concrete to be placed—not poured. An effort is made to keep the lateral movement of concrete in the forms down to a minimum, and it is specified that the concrete be placed with vibrators. This eliminates the necessity for high workability and makes possible a reduction in the water-cement ratio. By these means, a high degree of economy is obtained with no sacrifice in quality. Aggregate used in the mass concrete ranges in size from 3-in. rock down to about 5 percent passing the No. 100 sieve. A uniform gradation such as this tends to reduce the amount of cement needed and to increase the workability.

The cement content varies in different parts of the dam. In general, mass concrete placed below the water level contains 4.1 bags of cement per cu yd; mass concrete at the water line and above has 4.4 bags per cu yd; and thin-walled structures such as intakes contains as much as 6.7 bags per cu yd. Type II cement is used plus an air-entraining additive. The typical mix designed for structures below the water surface has a water-cement ratio of 1.228. Quantities, based on absolute volume for 1 cu yd of concrete, are: cement, 0.0725; air, 0.0452; water, 0.0892; coarse aggregate, 0.6027; and sand, 0.1904. A maximum size aggregate of 3 in. is required along with a specified aggregate gradation. The maximum slump is $1^1/_2$ in. Because the commercial sand used contains no fines, a silt sand is added to get the required gradation.

Construction progress

The first work on the project began in 1948. The Dunbar & Sullivan Dredging Company of Detroit, Mich., received the first contract and subsequently a second contract totaling $794,730. The two contracts involved dredging the channel to a 9-ft depth in a 2,250-ft reach of the river just below the lower dam. The excavation amounted to 327,000 cu yd.

In the spring of 1950 the contract for the lower lock and dam was awarded to Johnson-Kiewit Construction Company, and work began in July of that year. Johnson-Kiewit represents a combine of the Al Johnson Construction Company of Minneapolis and Peter Kiewit Sons' Company of Omaha, Nebr. The co-venturers submitted a low bid of $5,508,968, but various modifications increased this cost considerably.

Plans for the construction of the lower lock and dam include four different stages in order to leave two-thirds of the channel open for river flow. For Stage 1, a cofferdam extended out from the left bank approximately one-third the width of the river. For Stages 2 and 3, the cofferdam encloses the lock along the right bank. Stage 4 will be done in an island cofferdam while the river flows through the completed parts of the structure. At present, Stage 1 has been completed and Stage 2 is under construction.

The contractors have had to battle unusual conditions. The adopted height of the cofferdam for Stage 1 was based on high-water data recorded since 1907, but high water flooded this cofferdam three times. The most disastrous flood occurred in the fall of 1951. A warm spell broke up the ice on the river and caused the river to rise. When the weather turned cold a unique situation arose. The river started to freeze from the bottom, causing the water level to reach a record height. This happened so suddenly that much equipment and material were damaged or lost. One large Bucyrus-Erie crane was left in the cofferdam during the flood.

Cofferdams and foundations

The cofferdam for Stage 1 included 17 circular pile cells 28 ft in diameter. This cofferdam enclosed the non-overflow section and Piers 1 and 2 of the dam (Fig. 3). After excavation for the foundations began, it was found necessary to drive an additional inner wall of sheetpiling to reduce seepage through the sandstone. The contractors encountered considerable trouble when they began excavating for the foundations. Original borings had indicated that the St. Peter sandstone was a homogeneous material of uniform density. However, excavation in the formations revealed horizontal seams 4 to 6 ft on centers, which when exposed, created an unstable condition resulting in numerous break-throughs. When a break-through occurred, it was closed by using a chemical grout and backfilling. Because of leakage through interlocks, the inner wall of sheetpiling proved inadequate. This led to the adoption of a well point system which proved very effective, especially in the deep key section along the upstream face of the dam. The well points, spaced 3 to 4 ft apart, were driven to a depth of about 24 ft below the foundations. By constant pumping they could effectively lower the water table. Usually the well point system formed an enclosure around the working area, but on occasion well points had to be put inside the concrete forms. When they were placed within forms, pumping was continued until the concrete had set, and then the piping was cut and plugged. Special care was necessary to avoid driving the well points through the impervious layer of siltstone because of the artesian pressures below this stratum.

These methods were developed in Stage 1 and extensively used in Stages 2 and 3. The well points were especially effective in Stages 2 and 3 while fill concrete was being poured for the foundation of the lock.

The flood waters of 1952 washed out much of the sandstone foundation where the lock will be placed. This washed-out material has been replaced with fill concrete. Since some spots were scored so deeply that well points proved ineffective, a considerable amount of tremie concrete was used. Most designers require that tremie concrete contain 7 bags of cement per cu yd and a maximum size aggregate of $1^1/_2$ in. However, studies made by C. W. Buending and W. L. Schultz of the Corps' St. Paul District revealed that a satisfactory tremie concrete could be made with $6^1/_2$ bags of cement and 3-in. aggregate. This mix represented a considerable saving in cement for the fill concrete. A coat of asphalt, placed between the fill concrete and the lock floor, prevents any bond between the foundation and the floor. Since the lock is designed to be set on an elastic foundation, the asphalt was required to eliminate any transfer of stresses from the fill concrete into the lock.

Major quantities for the entire project are given in Table I.

TABLE I. Quantities for entire "Upper Minneapolis Harbor Development" project

Channel dredging	Lower pool	320,000 cu yd
	Intermediate pool	80,000 cu yd
	Upper pool	1,000,000 cu yd
Lower Lock and Dam	Excavation	104,000 cu yd
	Concrete	84,000 cu yd
	Reinforcing steel	2,500,000 lb
	Structural steel	1,900,000 lb
Upper Lock	Excavation	183,000 cu yd
	Concrete	107,000 cu yd
	Reinforcing steel	8,000,000 lb
	Structural steel	1,100,000 lb
Structural steel	Guide fences, Railroad bridge, Alterations	8,800,000 lb

The present estimated cost of the entire project is $29,795,500; and it is 22 percent completed. The lower lock and dam are 60 percent complete and should be finished in December 1955. The city of Minneapolis contributed $1,100,000 and will bear the cost of the bridge modifications and any alterations to utility structures located in the channel. Col. A. H. Bagnulo, St. Paul District Engineer, is in charge of the entire project. Other Corps of Engineer personnel include E. J. Christenson, A.M. ASCE, Chief of the Construction Division; Emil Silverman, Project Engineer; C. W. Buending, Resident Engineer; and W. L. Schultz, Assistant Resident Engineer.

Performance type of building code gives scope for engineering ingenuity

EDWARD J. McGREW, JR., M. ASCE, Chairman, New York State Building Code Commission, New York, N.Y.

The performance type of building code is an instrument which encourages engineers and architects to use their knowledge and experience to the maximum. Traditional specification-type codes, on the other hand, unduly restrain those engaged in building design from employing in full measure their knowledge and ingenuity.

Bearing in mind that the fundamental purpose of a building code is to protect the users and occupants of a building from the hazards of fire, collapse and insanitation, a true performance code might theoretically consist of one simple sentence: "The building shall be designed and constructed to withstand safely all of the forces to which it will be subjected." This, of course, would approach the ridiculous.

The specification code, however, approaches the ridiculous in the opposite direction. For example, the typical specification code will prescribe what walls must have a fire-resistance rating of 4 hours and then proceed to describe in detail exactly how such walls must be built, precluding entirely the use of new materials or methods of assembly that might adequately meet the fire resistance requirements and provide the stability needed for the type of construction prescribed. The performance code, however, will specify only the fire-resistance rating required and the necessary stability under fire conditions, leaving to the designer the selection of the material and the method of assembly for accomplishing the desired end. Thus the typical specification code confines within narrow limits the materials and methods of assembly which the designer may employ, while the performance code prescribes the objective only, and opens up to the designer the entire field of his training and experience, plus the research of the laboratory scientist, from which to choose the most suitable solution to the problem. The performance code therefore offers for the first time in the field of building design and construction the same scope for the talents of the engineer that he has traditionally had in the field of heavy construction.

Critics of the performance code will say that it is not sufficiently definitive to furnish the designer with the signals he requires, thus opening the way to arbitrary enforcement which may require repeated design changes, with attendant increases in design costs. Such criticism is inspired by the lazy mind, which would rather placidly accept the cut-and-dried prescription which offers no grounds for misinterpretation than search for innovation and support the new solution, in the interest of the client, with militant confidence. Advocates of the performance code welcome the opportunity offered to serve their clients more effectively and economically.

New York State code revised

The New York State Building Code Commission has been called upon by statute to formulate a performance code. As a considered policy, it has drawn liberally on the best engineering talent for advice. The result is a code approaching—within the bounds of practicability and far beyond any other code previously written—the true performance type of specifications.

Thus far the Commission has developed that part of the State Code applicable to one- and two-family dwellings (admittedly not a good field for the engineer as it does not offer him the challenging problems it does the architect); and that part applicable to multiple dwellings (offering limited scope to the engineer). Currently the Commission is developing that part of the code which is applicable to all non-residential construction—commercial, industrial, storage, and institutional (the field in which the engineer has a real, an essential place).

There is a Code Manual, advisory and interpretative only, and not the law, which has been evolved to set forth the usual or conventional means of meeting performance requirements, for the guidance and ready reference of the building inspector but in no measure limiting the ingenuity of the engineer.

The New York State Building Code is being developed for the use of the communities of the State of New York. Its acceptance is voluntary on the part of communities by simple resolution of the local legislative body. Such communities may withdraw at any time after one year of operation under the code. As of this writing, 128 municipalities of the state are operating under the code, and many others have indicated considerable interest.

Progress in uniformity

A gradual but very real development of value to the architect, the engineer, and the builder is taking place in the State of New York—that is, uniformity. The importance of uniformity is probably obvious. For example, in Westchester County, where there were 37 separate building codes in the 46 communities, allowable stresses in steel in tension vary all the way from 16,000 psi to 20,000 psi, and many other less apparent but equally important provisions vary as widely and with no more basis in scientific fact or acceptance. Uniformity has already made progress in Westchester, where 16 of the 46 communities have already accepted the State Code.

The State Building Code Commission has taken another significant step which should prove a boon to the construction industry. Instead of developing independent provisions with respect to such things as steel, plumbing, or electrical design and construction, the new code has been written in broad general performance terms, supplemented by the specific statement that construction in accordance with generally accepted standards meets the requirements of the code. A list of generally accepted standards recognized by the Commission is published by the Commission and furnished with each copy of the code. Thus the designer can proceed with confidence in the knowledge that design in accordance with generally accepted standards, usually those with which he is most familiar, is sufficient evidence of compliance with the requirements of the code.

We all recognize the constant progress being made in the design and construction arts. We accept experience and ingenuity as attributes that mark the truly professional engineer. Why not then, in writing our building codes, take advantage of these valuable creative and cost saving qualities?

AEC gaseous diffusion plant—Portsmouth, Ohio

Pike County site prepared

DAVID J. BRUMLEY, A.M. ASCE, General Engineer, Atomic Energy Commission, Portsmouth Area Office, Portsmouth, Ohio

For the construction of its Portsmouth Area project the Atomic Energy Commission announced the selection, in August 1952, of a 3,700-acre site in Pike County, Ohio. See Figs. 1, 2, and 3. On a plateau just east of U. S. Highway 23, 20 miles north of Portsmouth and 25 miles south of Chillicothe, the construction of the huge plant, estimated to cost more than $1,200 million, is being expedited to meet construction schedules.

It was only after extensive investigation of possible locations in many parts of the nation that the final selection was made, based on factors favorable for the gaseous diffusion plant. Although ample population centers were available within driving distance of the plant, only 24 families, or approximately 100 people, were occupying the site at the time of purchase and less than 40 farms were located within its metes and bounds.

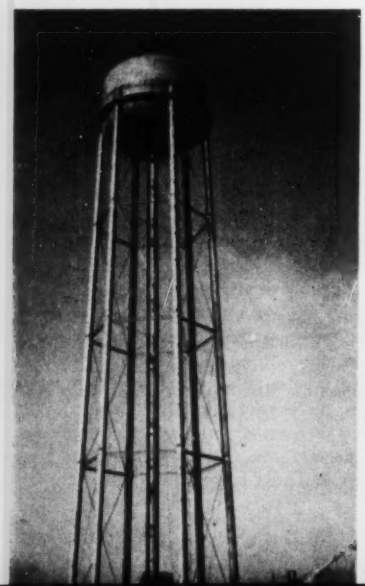
The purpose of the AEC's gaseous diffusion plants, such as the one at Portsmouth, is large-scale separation of the uranium isotope 235 from a chemical compound of uranium by the process of gaseous diffusion through porous barriers. These barriers must contain billions of holes smaller than two-billionths of an inch, withstand a pressure head of 15 psi, cannot become enlarged or plugged by corrosion or dust, and must be amenable to manufacture in large quantities (measured in acres) and in uniform quality. The process involves several thousand stages. No plant exactly similar to the one at Portsmouth has ever before been contemplated.

A primary consideration was the ability to obtain large blocks of interim and permanent power. How this power, the largest single block ever supplied in this country, is being generated and transmitted to the plant by the Ohio Valley Electric Corporation is described in the article by Philip Sporn and H. A. Kammer [which follows in this issue].

Of equal importance is a dependable source of water. The Scioto River provides such a supply. An average annual precipitation of approximately 38 in. over the 6,500 sq miles of watershed provides ample water for the plant.

Although the AEC is not constructing and operating a community in the Portsmouth Area such as those at Oak Ridge, Los Alamos and Richland, suitable housing is becoming available through private construction. Population centers such as Portsmouth, Chillicothe, Jackson, Waverly and numerous other

Overhead tank of 250,000-gal capacity serves both temporary and permanent sanitary-fire water system.



Dependable source of water is Scioto River. Prestressed reinforced concrete pipeline of 48-in. diameter extends from river pumphouse to water treatment plant. This pipeline is here seen being backfilled.

FIG. 1. Site of Portsmouth Area project of AEC was chosen after extensive investigation of possible locations in many parts of the nation.

communities, will provide housing for the permanent operating staff and their families.

Two railroads and U. S. Highway 23, which is being widened to four lanes from Portsmouth to Chilicothe, will provide excellent transportation facilities to the site.

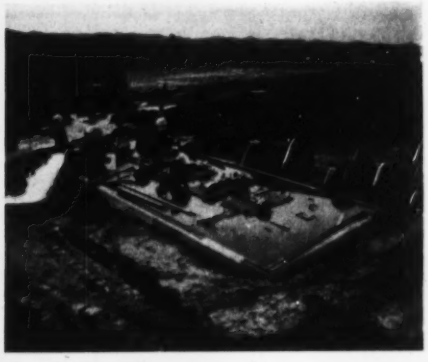
River and wells supply 40 mgd

One of the first requirements on the construction job was the development of a water supply to serve construction personnel and field work. This was accomplished by making use immediately of a ground-water source of supply. The yield from three 16-in. developed wells, as determined recently by the U. S. Geological Survey, will be sufficient for the eventual 4-mgd sanitary-fire demand of the plant. During the ground-water exploration, two test wells were drilled in the area above the flood level; each indicated a yield of only one-third that of a similar well located on the flood plain.

During low flows in the Scioto River, tests of the well water reveal an average alkalinity of 290, hardness of 320, and chlorides ranging between 3 and 7 ppm. Water softening equipment is mandatory at the steam plant and laundry, and plans are under way to provide for the addition of sodium septaphosphate at the wells to serve as a conditioning agent for stabilization of the water with respect to scale and corrosion control.

Concurrently with the development of the wells, a 16-in. supply main, approximately 2.7 miles in length, was laid to connect the wells to the distribution system supplying the temporary administration and warehouse areas. Water is chlorinated at the well. A booster station, housing three electrically driven 850-gpm pumps, a standby electrically driven 2,500-gpm pump and a diesel generator, is located about 3,000 ft from the overhead storage tank. These booster pumps maintained the necessary main pressures for fire fighting and sanitary demands until November 1953, when the permanent 250,000-gal overhead tank was tied into the system. Considerable economies were realized by expediting the erection of the permanent overhead tank and the laying of the permanent supply mains before most of the building construction. Temporary pipelines from tees in the permanent system provided water for curing concrete, compacting fills, and other construction uses.

Motors for the three 850-gpm booster pumps, which maintain the level in the overhead tank, are controlled by a three-step telemeter system. A transmitter located in the valve pit at the base of the overhead tank relays predetermined stages in water-tank levels to a receiver in the booster station. The cycle of operation of the pumps is con-



Floor for booster pumphouse, with bases for the three 850-gpm booster pumps, is in place. Discharge from well pumps is flowing from one of the valved inlets.

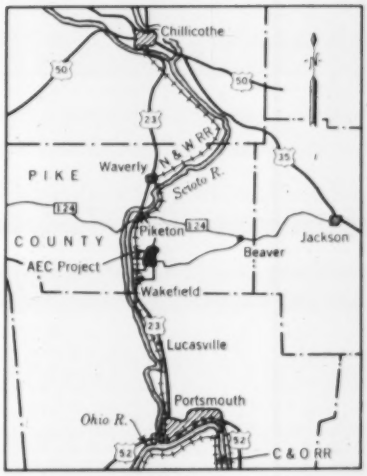


FIG. 2. Project is situated on plateau 20 miles north of Portsmouth and 25 miles south of Chillicothe, Ohio. Transportation is provided by two railroads and U.S. Highway 23.

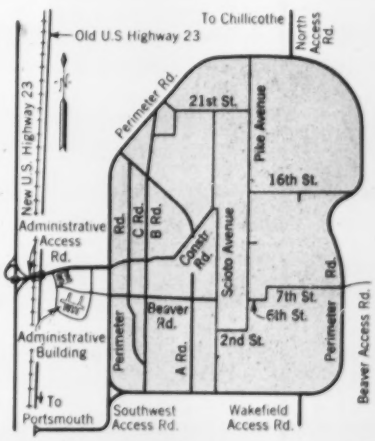


FIG. 3. Site in Pike County, Ohio, contains 3,700 acres. On it 30 miles of road and 27 miles of railroad have been built.

trolled automatically, and alternators provide for automatic rotation to equalize pump usage. The 2,500-gpm pump is controlled manually, and for the present demand is used only as a standby unit to provide additional pressure at capacity operation.

Main pressure in the line at the well pumphouse controls and regulates the well pumps. A small pipeline bypass around the booster-pump check valves permits transmission of the head in the overhead tank to the supply line. Operating experience has resulted in providing for a 3-sec delay between the starting of the first booster pump and the first well pump. The cut-on and cut-off of the remaining pumps have been similarly synchronized to obtain the most efficient operation.

Although the wells in the flood plain provided an expeditious source for a sanitary-fire water supply, their vulnerability to major floods on the Scioto River made necessary the inclusion of a 4-mgd filter plant as part of the 40-mgd water treatment works, which serves both process and sanitary-fire system demand.

The water treatment system contains three major components—a river pumphouse, raw-water line, and treatment plant. The pumphouse, a six-story concrete structure designed for pumping within the seasonal minimum flow of 300 cfs and flood flows (113,000 cfs at Columbus, Ohio, during the flood of 1913), will house six pumps, one of which is a standby. Provision is made for chlorination, removal of river debris by traveling screens, and emergency lighting from batteries. A 48-in. prestressed concrete pipe conducts the 36-mgd prechlorinated raw-water supply to the treatment plant for normal process demand, but is large enough to conduct the total plant requirement of 40 mgd.

There are two buildings at the water treatment plant. The chemical building houses bins and open storage on the second floor. On the first floor are located the chemical feed room, chlorine storage and feed rooms, laboratory, and control room. The second building contains the sanitary water facility comprising the pump room, clear wells, filters, and pipe gallery.

The incoming line will branch into three separate lines, one a bypass line for the raw water to the secondary rapid-mixing basin, the second a connection to the primary rapid-mixing basin, and the third a connection to the slow-mix basin. The type of treatment will depend on the condition of the raw water, which may vary seasonally in hardness and turbidity.

Activated carbon will be added to the water delivered to the sanitary water facility. The clarified effluent from the carbon settling basins will flow by gravity into the sand filters. The water from the filters will collect in clear wells for chlorination and pumping into the sanitary-fire water distribution system. Pipe sizes in this system, comprising over 56,000 ft of pipe, were determined to meet fire and other emergency demands. The process water system is made up of some 67,000 ft of pipe, 72-in. and smaller.

The lime sludge from the treatment plant flows by gravity to lagoons, from which the supernatant will overflow into a natural stream bed.

At the start of construction, sanitary wastes were handled by means of chemical toilets. These were supplanted by lavatories and water closets as rapidly as possible and, by the time administrative and clerical personnel moved from temporary offices in Portsmouth to the plant site in April 1953, a temporary sewage collection system and septic tank were in operation.

The outfall line from the permanent sewage treatment plant extends for about 11,000 ft to the Scioto River. Over 4,800 ft of the permanent outfall line is being used for the effluent from both the temporary septic tanks and the permanent sewage treatment plant.

The permanent plant will consist primarily of a settling, filter and final settling process, with a digester to treat the sludge taken from the sewage. The approximate 450,000 gal per day estimated sewage influent will be made up of sanitary waste and also ground garbage from the plant cafeteria. Except for two remote facilities served by septic tanks, the entire plant will be tied into the collection system. Located on the approximately 25,000 ft of collection piping are: (1) a lift station housing two alternating 180-gpm non-clog submersible pumps, and (2) a pumping station housing three alternating 300-gpm non-clog pumps for dry-pit operation. Both stations are operated automatically by float control switches and will be unattended. However, a high-water alarm will immediately transmit a warning to operating personnel if the pumps are not operating.

The pumping station discharges through a 10-in. force main to the sewage treatment plant some 2,600 ft distant. At the entrance to the treatment plant the influent raw sewage passes through a bar screen and comminutor into a primary settling basin of 28-ft diameter. The clarified liquid flows by gravity to a trickling filter of 45-ft diameter, and the sludge is pumped to the digester. After organic substances in the sewage are oxidized and mineralized, the neutralized liquid from the trickling filter flows by gravity into the 28-ft final settling basin, where the remaining solids are allowed to settle. The treated effluent is diverted to the outfall sewer.

Sewage treatment plant is designed for estimated influent of 450,000 gal per day. Construction view shows sludge drying beds in foreground, and beyond, at left, sludge digester and control house. In center background is primary settling tank with trickling filter adjacent at right.

The sludge on the bottom of the final settling basin is pumped to the digester.

The digester tank, of 30-ft diameter, receives sludge from the settling basins at a controlled rate. After digestion, the deactivated sludge is discharged into the drying beds. The digester control house is a reinforced concrete structure attached to the side of the digester tank. Its installed equipment includes two 75-gpm sludge pumps, sewage meter, flushing-water pump and tank, sump pump, hot-water circulating pump, and hot-water boiler.

The sewage treatment plant is located on the west side of the plant area at an elevation approximately 20 to 30 ft lower than the average ground-floor elevation of the various facilities. The effluent elevation provides ample static head for flow through the outfall sewer. The sewage treatment plant was ready for preliminary inspection in April 1954, just nine months after the start of its construction.

6,000,000 cu yd of earth moving

To provide a suitable area for constructing the process and auxiliary buildings, a strip of land roughly 4,000 × 6,000 ft was graded to minimum slopes for surface drainage. Bounding this area is a "perimeter" road to be used during construction as a haul road and later as a part of the permanent access or patrol road. Altogether for the project about 6,000,000 cu yd of excavation and backfill was required for site grading.

Several types of fill were specified depending on the compaction and bearing capacity required. In areas not requiring special compaction, a Type A fill was spread in layers approximately 1 ft thick. No special compaction was required other than that obtained by the equipment used for transporting and spreading the material. The top 4 ft was constructed with approved lean clays obtained from excavation below the stripping level. Type A was used principally in the construction of storage lots.

In constructing the Type B fill, earth obtained from excavation or borrow was spread evenly to such a depth that, after compaction, the layers were not thicker than 6 in. Rolling was accomplished by means of sheepsfoot or pneumatic rollers, sufficiently weighted to produce the required compaction of 95 percent. The Type B fill was used extensively in road, railroad, parking lot, and switchyard construction. When the moisture content of the earth obtained from borrow or excavation was such as to preclude attainment of the specified degree of compaction, Type C fill was used.

Type C fill is a mixture of stone and soil, consisting of crusher-run stone and a sufficient amount of soil to make possible the specified degree of compaction (95 percent of maximum density as determined by ASTM Specification D-698) by ordinary rolling equipment without the use of vibratory means. Approximately 400,000 cu yd of this type of fill was used for the plant site. The soil component, obtained from excavation or borrow, was free of organic matter, rubbish, and stone fragments larger than 2 in. No frozen material was included. The stone was limestone, having a minimum crushing strength of 1500 psi. All the stone passed a 2-in. sieve, with the amount passing a No. 4 sieve not exceeding 40 percent nor less than 15 percent.

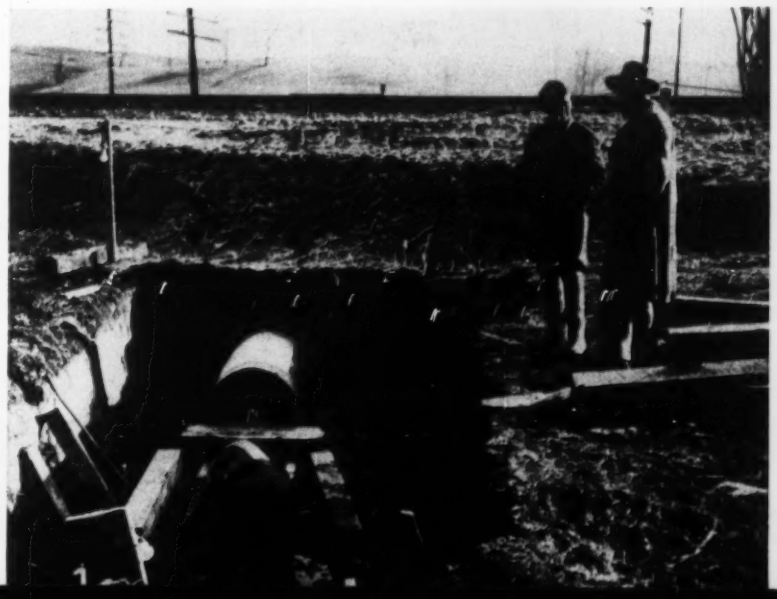
In constructing the Type C fill, graded stone was hauled by truck from a quarry about 18 miles from the plant site. The stone was spread and placed in separate operations. The required amount was spread and followed by the specified amount of selected soil so that when mixed and compacted, the depth did not exceed 8 in. The stone and soil were windrowed by blade to produce a homogeneous mass and then rolled with sheepsfoot and pneumatic rollers to accomplish the specified compaction. After some experimentation, this method was replaced by the use of a combined pulverizer and mixer that was able to blend an approximate 4 in. of uncompacted soil with 4 in. of uncompacted stone. Fill operations were started in the lowest area and carried up to the top of the fill at a slight slope to encourage surface runoff. In advance of forecasted heavy rains, the top surface of the fill material was rolled to tighten or seal the surface and prevent excessive absorption. The rolled surface was plowed before the resumption of fill operations.

In February 1953, a stationary asphalt plant was erected and kept in readiness to reduce the moisture content of stone and soil if required. Stone dumped in the entrance to the revolving drum can be heated to approximately 300 deg F and an approximately equal amount of clay added. The mixture of stone and soil, as discharged from the drum, will contain the proper moisture content. Neither the amount nor intensity of rainfall occurring during the grading operations required the use of the asphalt plant.

For the smaller quantities of Type C fill used for backfilling footing and underground utility excavations, it was found expedient to mix and blend the stone and soil in a central location and then haul the mixture to the site of the work.

The Type C fill was specified primarily to permit wet-weather construction of stable fills for building foundations. The foundation design is predicated on this type of fill with regard to magnitude and rate of settlement of the building footings. The magnitude depends on the degree of compaction obtained, and the rate will depend on

Outfall for sewage treatment plant extends 11,000 ft to Scioto River. Here 30-in.-diameter corrugated metal sleeve for outfall is being jacked under main line of Norfolk & Western Railway.



the degree of perviousness imparted to the lean clay by the quantities of crushed stone added. Where fill under the larger process buildings exceeded 4 ft in depth after stripping, a drainage blanket 12 in. in compacted depth was first constructed over a ground surface which was graded to drain to a low point. A 2-in. bottom layer of screenings was covered with a 10-in. top layer of crushed stone, the top of which was choked with screenings. The top layer was placed in a 4-in. and 6-in. lift with thorough rolling by a 10-ton roller after the first lift. The low point of the drainage blanket was connected through a 4 × 4-ft french drain to a sump located outside the building lines. Water drained to these sumps either was pumped to an open channel or diverted into a storm sewer. Drainage has appeared in the sumps as long as 90 days after the weight of the building was applied.

An allowable bearing pressure of 4,000 psf was assigned to the Type C fill. Architect engineers have used this standard in the design of footings, earth-supported floors, ducts, and other underground structures.

Field density measurements were determined from 4-lb samples. Under footing locations, 4-in. auger borings were taken for visual classification of soils. Some 50-75 standard Proctor curves were developed for the various soil types.

Central concrete plant erected

One of the "basic commodities" used on the construction job is concrete. In order to standardize and simplify the design, batching, mixing and delivery procedures, four general classes of concrete were developed, having the following specified uses and 28-day strengths:

Type	Designed Strength	Yardage placed as of June 1954
A	3,000 psi	64,700 cu yd
B	2,500 psi	235,900 cu yd
C	2,000 psi	20 cu yd
D	1,000 psi	10,600 cu yd

Aggregate for Types A and B was either 1½-in. to No. 4 sieve or 1-in. to No. 4 sieve. In types C and D, all the aggregate was 1½-in. to No. 4 sieve. The 1½-in. maximum size aggregate was used generally for mass concrete and the 1-in. maximum size for reinforced concrete. All types of concrete contained from 240 to 250 gal of water per cu yd, with a limiting slump of 4½ in. On the basis of laboratory tests, 15 to 20 percent natural cement was blended with the portland cement.

Type A concrete was developed for floors requiring special wearing qualities and was used also for footings and walls. Most of the concrete in the power switchyards was Type A. The most widely used structural concrete for floors and footings was Type B. Type C concrete was originally designed for use in preparing mud mats, but was superseded by one of the special mixes. Type D has been used to replace unsuitable soil under foundations and footings, rather than backfilling with compacted soil. An air-entraining agent was added to the various mixes at the concrete plant to provide an entrainment of approximately 4 percent.

Although these four standard types of concrete were used extensively, other mixes were developed for special uses. For water-retaining structures, a six-bag mix having a limiting slump of 4½ in. was employed, and as of June 1954, approximately 34,100 cu yd of this mix had been placed. After some experimentation it was found that a 300-psi concrete, whose cement content contained approximately 50 percent natural cement, would serve well for backfill.

The limited clearances between reinforcing and ducts in concrete-encased underground electrical and communication systems posed the problem of finding a special concrete. The 7-percent air entrainment and 5- to 7-in. maximum slump resulted in a workable and fluid concrete. The developed mix contained 516 lb of cement, 1,252 lb of sand, and 1,743 lb of ½- to ¼-in. aggregate per cu yd. As of June 1954, approximately 17,200 cu yd of this 5-in.-maximum-slump concrete had been placed.

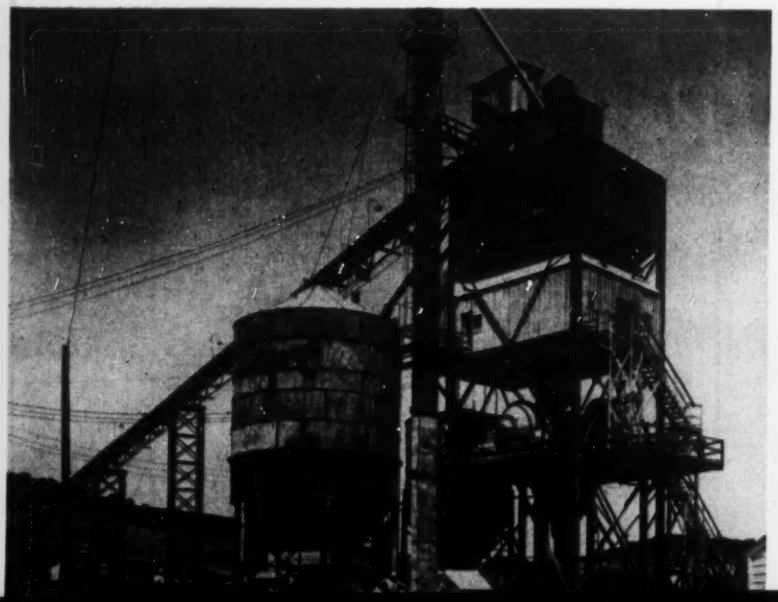
To provide the yardage needed, a fixed-price subcontract was awarded in February 1953 for furnishing materials and for batching, mixing, transporting, and delivering estimated yardages of the standard types of concrete. A plant with a capacity of 200 cu yd per hour was erected at one end of the project site where rail sidings were available in addition to haul roads. Beginning March 9 1953, concrete was hauled from an off-site plant until April 20, 1953, when the first concrete was produced on the site. As of June 1954, about 383,000 cu yd of the estimated 445,000 total had been delivered to the project construction.

Coarse aggregate larger than ¼ in. was hauled by railroad cars from pits 30 to 45 miles from the project site. During full operation of the plant, approximately 36 carloads of aggregate were required per day. Most of the sand was hauled by railroad cars from a pit 30 miles from the project site. The remainder of the sand was trucked in from a pit less than a mile from the site. No blending of the sand at the plant site was necessary.

The daily cement requirement was approximately 2,500 barrels. Most of the portland cement was hauled by rail from manufacturers located 30 to 35 miles from the site, and natural cement was delivered by rail from Louisville.

The specifications for concrete required a minimum placement temperature of 50 deg F. This temperature was maintained during periods of cold

Batching and mixing plant, of 200-cu yd per hour capacity, will mix more than 400,000 cu yd of concrete to be used on project.



weather by using live steam for unloading cars into the underground pit and steam coils in the plant bins. Controlled heating by live steam was permitted in the stock piles during extended periods of low temperatures.

The comparative compressive strengths of field-cured and laboratory-cured cylinders has been determined continuously since the start of concrete work. Enough specimens were taken for: (*a*) two cylinders for field curing in water, (*b*) two cylinders for field curing in damp sand, and (*c*) control cylinders for curing in the laboratory moist room. The forms on the (*a*) and (*b*) cylinders were removed after 24 hours and the (*c*) cylinders were brought immediately to the laboratory. The field-cured cylinders were taken to the laboratory two days in advance of the testing date. During the summer months the seven-day strength of the field cylinders was greater than that of the laboratory cylinders. During the winter months the field cylinders tested only 80 to 85 percent of the laboratory cylinders. Field laboratory tests of the sand and coarse aggregate were also made at regular intervals.

Special floor forms devised

The floor area of the permanent buildings of the plant will total 9,000,000 sq ft—approximately 210 acres. An additional 1,200,000 sq ft of floor space will be included in the temporary buildings.

The fabrication and erection of formwork for the upper floors of the larger structural steel process buildings is typical of the close teamwork between the engineer and the contractor. The architect-engineers employed uniform column spacing and pouring details, wherever possible, to assist the prime contractor in the intricate layout of the formwork. A coding system for the various bays of the building was carefully planned for use in the assembly, storing, and erection of formwork. These coding sheets were scheduled so that the formwork could be completed at least two weeks in advance of the pour.

The rectangular floor pans were prefabricated at the mill yard from $\frac{3}{4}$-in. plywood, which had been previously oiled at the factory. Joists of 3 × 8-in. lumber were precut and stored at the mill yard along with the plywood, in conformity with the coding system. In placing the forms, temporary wooden joists were first wedged against the top web of the permanent steel framing by means of wooden blocks driven securely against the lower web. On top of the joist the plywood panels or pans were laid. No falsework was required.

The permanent overhead cranes in the buildings were used for placing the concrete either directly in the forms or by means of hoppers and power buggies. The larger pours totaled 15,000 to 28,000 sq ft per day. Mechanical vibrators were used to work the concrete into place. Stripping was accomplished after a 2,000-lb test was secured, for concrete designed for a 2,500-lb strength at 28 days. During the summer the 2,000-lb strength was reached in five days, but in cold weather a period of eight or nine days was required.

The surface was screened to elevations determined by steel pins previously welded to the steel beams at 5-ft intervals. Mechanical steel trowels provided an initial finish. A burnished surface was obtained by hand troweling. Burlap was placed over the floor immediately after the completion of finishing. Water curing was continued for seven days, with moisture maintained by hand sprinkling from hose nozzles.

The standardized column spacing and the system of coding contributed to the reuse of the plywood sections or pans as many as four times. The forms were cleaned and oiled before reuse.

Construction of the whole plant is expected to take about four years. However, the plant is so designed that it goes into operation in units or segments. As one unit is completed it is turned over to the operating contractor. Subsequent units are picked up "on-stream" as they are completed.

Kenneth A. Dunbar is the Atomic Energy Commission's Manager of the Portsmouth Area. He is assisted by R. H. McCulloh, Deputy Area Manager. Leo M. Buhr, Chief of the Engineering and Construction Division, directs the engineering, construction, supply, power, and control phases of the project. Other AEC division chiefs include: B. W. Menke, Administrative; W. C. Youngs, M. ASCE, Operations; and A. A. Vergari, Finance.

Field Representative for the Carbide and Carbon Chemicals Company, engineers for process design criteria and installation, is M. Bender. Architect-engineer resident managers at the project include; Roland J. Pfaendtner for Giffels & Vallet, Inc., process facilities; W. H. Hormberg for A. M. Kinney, Inc., site work and utilities; B. A. Whisler, for Alvord, Burdick & Howson, water and sewage treatment facilities; D. F. Godfrey for Sargent & Lundy, heavy electrical facilities; W. A. Scheer for Holabird & Root & Burgee, general-purpose buildings; Fred D. Lange for Smith, Hinchman & Grylls, Inc., technical services, cleaning and maintenance buildings; George Salmon for Singmaster & Breyer, feed manufacturing plant; and J. H. Scullion for Burns & McDonnell Engineering Co., steam plant.

Peter Kiewit Sons' Co. is the prime contractor for construction of the process and auxiliary facilities. George C. Holling is General Manager. The plant will be operated by the Goodyear Atomic Corporation, whose General Manager is A. J. Gracia.

At plant site, about 600,000 cu yd of Type C fill, mixture of soil and crusher-run stone, was placed. Motor patrol in foreground is spreading layer of soil. In center background, combined pulverizer and mixer is blending stone and soil into uncompacted layer. Tractor which pulls sheepsfoot roller is at extreme right.

AEC—Portsmouth

OVEC steam plants furnish 2,200,000 kw

PHILIP SPORN, M. ASCE and H. A. KAMMER, A.M. ASCE, President and Vice President, respectively, Ohio Valley Electric Corp.

Almost two years ago the Ohio Valley Electric Corporation (OVEC) and the Atomic Energy Commission (AEC) executed a 25-year power agreement calling for the supply of 1,800,000 kw, or 15 billion kwhr per year, to a gaseous diffusion plant which is being constructed by the AEC in Pike County, Ohio. This is the largest power contract ever entered into by a single customer in the 75-year history of the electric utility industry. In order to fulfill its commitments, OVEC and its wholly owned subsidiary, Indiana-Kentucky Electric Corporation (IKEC), are constructing two large steam-electric generating stations, one at Madison, Ind., having a net capability to feeders of 1,200,000 kw, the other at Cheshire, Ohio, which will have a net capability of 1,000,000 kw. The total cost of the two steam-electric generating stations and 400 miles of double-circuit 330,000-v transmission lines required to transmit the power to the diffusion plant, together with necessary interconnections with the private utility companies forming OVEC, will be in the order of $400,000,000.

OVEC was organized by a group of privately owned utilities. Participation by each member, both for the purchase of common stock in the new company and the furnishing and receiving of excess power, and power which would become available in the event of cancellation by AEC, is on the basis of their expected non-simultaneous power demand in 1954.

While it was originally intended that the equity holding in OVEC be entirely in the name of utility operating companies, the "great-grandfather" clause of the Holding Company Act of 1935 finally made it impossible to do this and, as a result, the common stock of OVEC is held by the following companies, which include both holding and operating companies:

American Gas and Electric Co.
The Cincinnati Gas & Electric Co.
Columbus and Southern Ohio Electric Co.
The Dayton Power and Light Co.
Kentucky Utilities Co.
Louisville Gas and Electric Co.
Ohio Edison Co.
Southern Indiana Gas and Electric Co.
The Toledo Edison Co.
The West Penn Electric Co.

As finally resolved, the financing of OVEC was set up on the basis that the maximum amount required to build the project, $440,000,000 (which includes anticipated escalation in the amount of 10 percent), would be developed by borrowing $360,000,000 from a group of insurance companies, pension funds, and savings banks on 3¾-percent mortgage bonds, obtaining $60,000,000 from a group of banks and pension funds on 14-year unsecured notes, and selling common stock to the above mentioned companies in the amount of $20,000,000.

Ground was broken for both projects early in December 1952. The agreement with AEC calls for the first unit at the Clifty Creek plant to be in operation in January of 1955, the sixth unit in June 1956. The first unit at the Kyger Creek plant is scheduled for operation in March 1955, the fifth unit in April 1956. The first section of the 330-kv transmission facilities (Fig. 1) is scheduled to be in service in August of this year and the last part in June 1955. As of this writing, all parts of the project are essentially on schedule, and it is expected that the scheduled operating dates will be maintained.

Civil engineering problems discussed

As would be expected in the development of a project of such magnitude, special problems arose in all the various fields of engineering involved. Those which we believe to be of particular interest to civil engineers are discussed here.

Turbo-generators. Each of the power plants will be equipped with cross-compound turbo-generators having a gross capability of 217,260 kw at 1½-in. Hg back pressure, operating at 2,000 psi, 1,050 deg F at the throttle, and reheat to 1,050 deg F. The high-pressure element of the unit will operate at 3,600 rpm, the low-pressure element at 1,800 rpm. Six such turbo-generator units are being installed at the Clifty Creek plant as shown in the plant layout and cross section, Figs. 2 and 3. The five units being installed in the Kyger Creek plant have a similar layout.

Boilers. Each turbo-generator unit is to get its steam from a single boiler with primary steam flow of 1,341,000 lb per hr and reheat steam flow of 1,190,000 lb per hr. Each boiler will consume approximately 89 tons of coal per hour. Seven pulverizers will be provided per unit to grind even the poorest quality of coal available in the area. Each boiler will be furnished with three Ljungstrom regenerative air heaters, two induced-draft fans, and two forced-draft fans, the latter of such size as to provide for full pressurized furnace operation. A two-stage slag-tap furnace design will be utilized to permit the use of ash-fusion coal at 2,000 deg F.

Electrical connections. The output of each turbo-generator will be transmitted by short, conventional, open bus runs through disconnecting switches to the step-up transformer bank. This bank consists of three single-phase 80,000-kva units with two 15,000-v windings, and a full-capacity 330-kv winding. The 330-kv winding of the transformer bank is connected to the transmission system (Fig. 1) which connects the plants to the AEC installation in Pike County, Ohio.

Earth moving. At each plant about 3,500,000 cu yd of earth was moved to build the plant grade up to an elevation above all flood levels except unusually high ones; to create areas for the potential storage of fly ash and cinders which the plant will produce during the first 20 years of operation; and to protect the coal storage area against erosion by the river during exceptionally high flood stages.

Consideration was given to the construction of a levee at each of the plants instead of raising the yard grade, but economics dictated the plan which was finally adopted, that is, to raise the plant grade to an elevation which long-time records indicated would not be equaled or exceeded but about once in 25 years. Bulkheads for window and door openings are provided for flood protection above the yard grade.

Practically all the earth was moved with tractor-scraper or similar equipment except for a stratum of difficult material which was encountered at the Clifty Creek plant site. The handling of this material delayed the construction program and called for the use of other types of excavating equipment. To remove this layer of material, which was high in moisture content, shovels and trucks had to be employed in combination with a wellpoint system.

To create the fly ash and cinder storage areas, as well as to protect the coal storage areas, earth dikes were constructed to a height of 35 ft above the original grade.

Dewatering. Lowering of the ground-water elevation in order to permit the installation of the condenser pit was accomplished at both plants by the installation of a wellpoint system in two stages. In order to hold to a minimum the length of the tunnels for supplying cooling water to the condensers in each plant, the plant was located as close to the natural river bank as possible. This required the installation of a rather extensive system of wellpoints and pumps to lower the ground water approximately 30 ft below the normal pool level. Under normal pool conditions, 7,500 gpm were pumped at the Clifty Creek plant and 2,000 gpm at the Kyger Creek plant.

Foundation conditions. Both the Clifty Creek and the Kyger Creek sites are typical Ohio River floodplain formations. Each site is underlain by two major soil strata: a stratum extending from the top of the flood plain to a depth of about 30 ft, which is chiefly clay; and an underlying compact, pervious stratum of sand and gravel extending down to bedrock.

Approximately one hundred exploratory borings were made at the two sites, and an analysis of the samples taken led to the decision to support practically all of each plant on spread footings and concrete slabs.

The physical arrangement of the turbine room and condenser pit, as will be noted from Fig. 3, permitted the bottom of the foundation slab to be founded in the sand and gravel stratum. However, in the boiler room and office room areas of both plants, the physical arrangements were such that the bottom of the foundation slabs coincided with the elevation of the clay strata. Therefore, to provide proper bearing for these structures, the clay was removed and replaced with a well compacted sand and gravel fill on which the foundation slabs were founded. In some areas the depth of this fill was as much as 20 ft.

Piles were used under some of the auxiliary structures where the elevations of the footings made their use economical.

Structural features. The substructures of the powerhouses are rather massive, requiring the placing of a total of about 225,000 cu yd of concrete for the Clifty Creek plant and about 200,000 cu yd for the Kyger Creek plant. At both loca-

In construction view of Clifty Creek steam station, looking south, structural steel is stored in foreground. Main building foundations are being placed in center of excavation, with stacks at left. Office building is at left of stack No. 2.

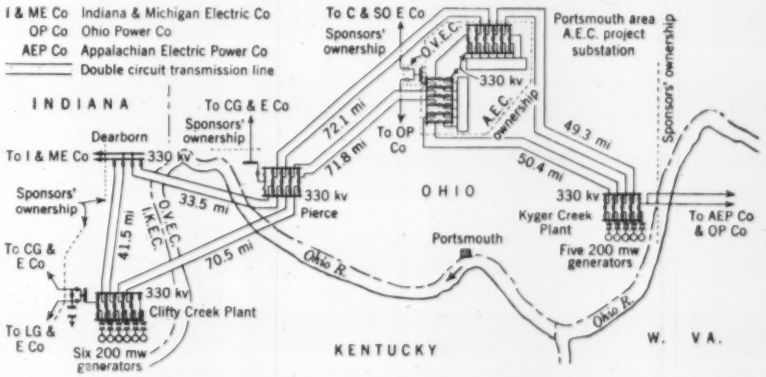
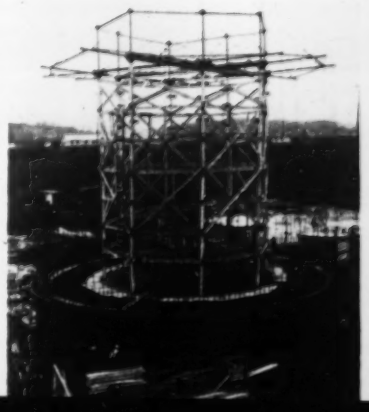


FIG. 1. Transmission system connects Portsmouth (Ohio) Area AEC Project with Clifty Creek and Kyger Creek steam power plants.

First lift is placed on stack No. 1 at Kyger Creek Plant. Three stacks are of reinforced concrete with inside base diameter of 51 ft and height of 538 ft above plant grade, or average of 300 ft above surrounding hills. Stack height and discharge velocity of 120 fps are designed to avoid trapping gases within river valley. These stacks, like those at Clifty Creek Station, were designed and built by Custodis Construction Co. of New York and Chicago.



tions, for most of the concreting operations, a mix is being used in which 20 to 25 percent of the cement is being replaced by fly ash. The fly ash is obtained from the participating companies' power plants, and in both cases is added to the concrete mix at the site of the work. It is expected that the predominant mix will contain approximately $3^1/_2$ sacks of cement per cu yd; at 28 days this will have an average compressive strength of 3,100 psi. The superstructure of the powerhouse will consist of a structural steel framework enclosed by a composite masonry wall built up of Speed-a-backer tile and 4 in. of brick, the tile forming the outside surface of the wall.

To provide proper isolation in the event of fire, each plant is divided into three sections. At both plants these barrier walls are constructed between the second and third, and the fourth and fifth units. To provide for operation of the turbine-room crane the full length of the plant, rolling metal doors make up the top section of the divisional walls in the turbine room.

Architectural features. A special study was made of the possibilities of adopting outdoor or semi-outdoor construction for each of the plants. The final decision was to provide the conventional type of enclosed superstructure except for the gas recovery equipment—air preheater, forced-draft fan, and mechanical and electrical precipitators. Carefully prepared estimates indicated possibilities of gross savings which were not only relatively nominal but which were more than

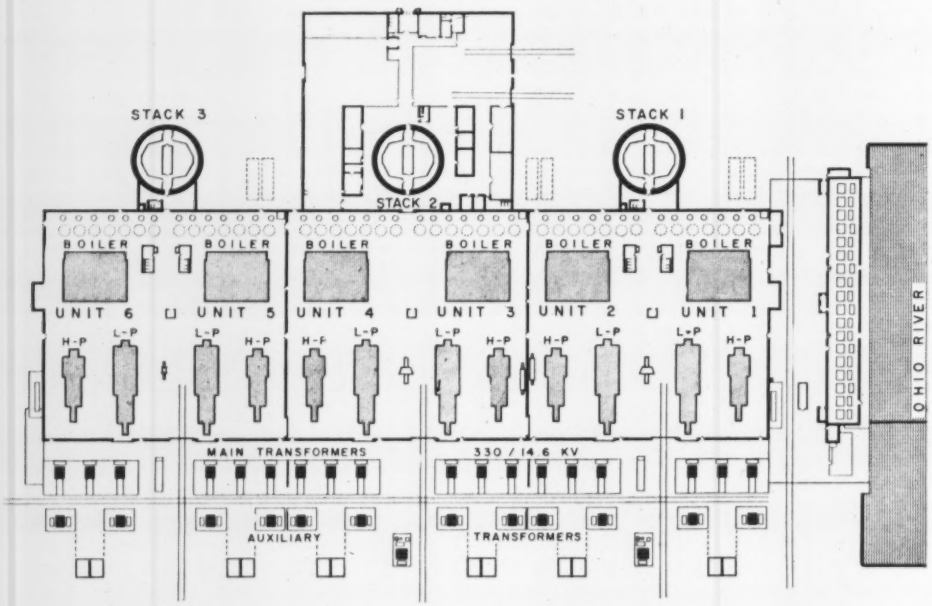


FIG. 2. Six turbo-generator units are being installed in Clifty Creek plant. Five units in Kyger Creek plant have similar layout.

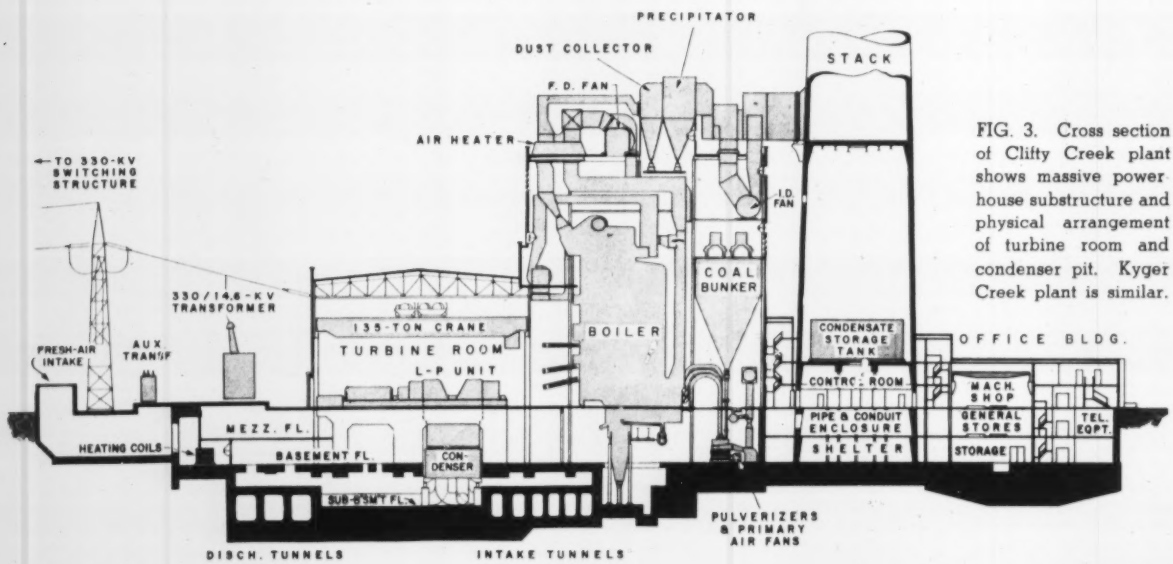


FIG. 3. Cross section of Clifty Creek plant shows massive powerhouse substructure and physical arrangement of turbine room and condenser pit. Kyger Creek plant is similar.

offset by major increases in maintenance and operating costs, and by lessened availability. This was particularly important for these plants where the expected load factor is of the order of 95 percent.

Every effort has been made to follow sound principles of functional and adornment-free architecture, relying on the proper relationship of mass, plane, and line to bring about a harmonious result. A particular effort was made, especially at Clifty Creek, to integrate the project in its entirety—coal and ash storage areas, the power plant itself, including the stacks—with the surrounding landscape.

Stacks. During the very early stages of planning, the proper control of stack discharge was fully taken into consideration. Therefore, in all subsequent design work the most modern equipment was specified throughout, and the best available technical methods at the disposal of the engineer, the scientist, and the meteorologist were marshaled in an all-out effort to protect inhabited areas near these plants from any possible combination of conditions which might be considered objectionable.

Studies on the control of stack discharge were undertaken jointly by the engineers, with nationally known authorities cooperating in special phases of the work. The studies began with an exhaustive review of all available technical information and past experimental data. Following this, the University of Michigan Engineering Research Institute was retained on a consulting basis, and its facilities at Ann Arbor were utilized to conduct wind-tunnel model tests. This test work was carried out during the winter of 1952–1953 and was concluded during the early spring of 1953. Over 480 test runs were made using various combinations of stack heights, wind velocities, and stack discharge velocities. Using results obtained from this experimental work, together with data covering earlier wind-tunnel tests, it was possible to predict the general behavior of stack discharge plumes under various wind conditions.

U. S. Weather Bureau records from official observation stations in the Ohio Valley area were obtained and analyzed. Topographic maps of the plant site were studied. The surrounding areas were inspected carefully and the effect of the local terrain on stack discharge behavior was analyzed. A well known meteorological expert was retained on a consulting basis during this phase of the study.

Heights finally selected were 682 ft above plant grade for the Clifty Creek station near Madison, Ind., and 538 ft above plant grade for the Kyger Creek station near Gallipolis. In each case the top elevation of the stacks was over 300 ft above the average height of the hills bordering the valley. In addition to the unusually high stack heights, a full-load gas-discharge velocity of 120 fps (82 mph) was selected to provide a jetting force to add appreciably to the upward velocity of the gas even with a strong horizontal wind.

The possibility of an atmospheric inversion occurring and trapping stack gases within the river valley was considered, and it was concluded that the most effective means of preventing this would be to have the stacks extend well above the level of the highest hills in the vicinity. The stacks, as designed, actually extend farther above the adjacent hills than do the stacks of most modern steam-electric plants above their own plant grade level. When and if an atmospheric temperature inversion is experienced, the discharge from the stacks will spread out and eventually be dispersed in the upper atmosphere far above

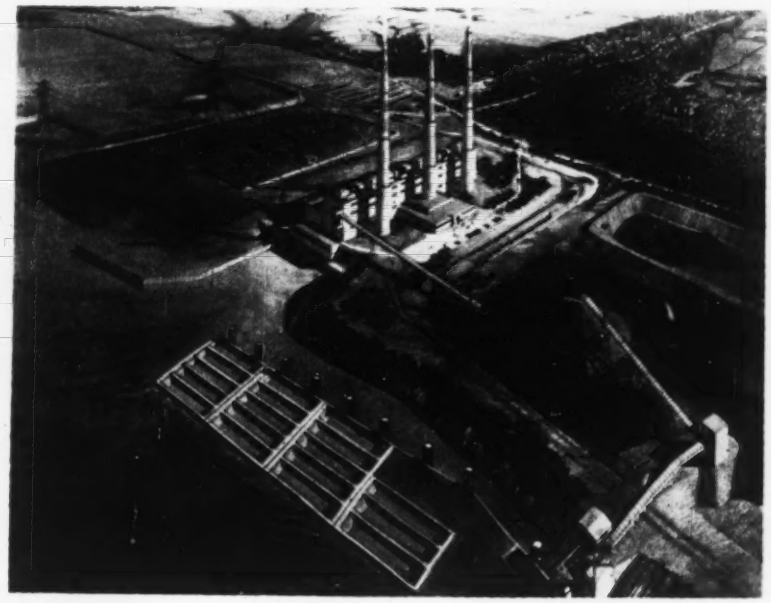
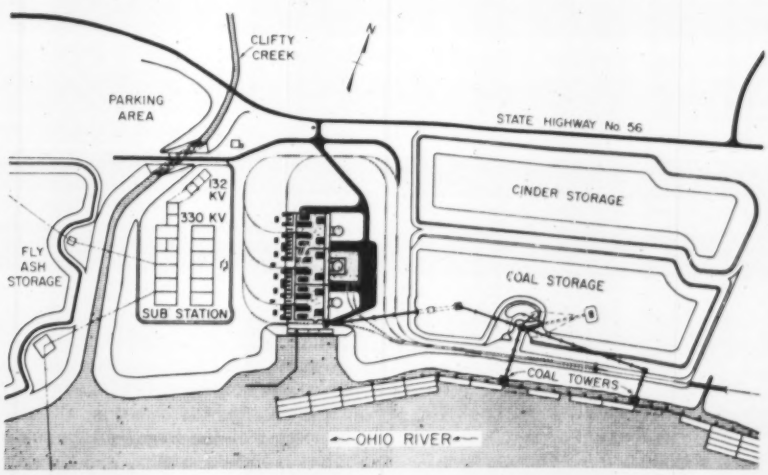


FIG. 4. Yard layout at Clifty Creek station provides for delivery of pulverized coal by barge to two hoisting towers. Thence belt-conveyor system transports it to bunkers in power plant. Coal storage, in right foreground of both aerial photo (above) and plan (below), will provide 1,300,000 tons, enough for three months' operation. Cinders and fly ash will be transported hydraulically to areas indicated.



the "lid" normally associated with such inversions and occurring at a level above the tops of the valley walls. Such a "lid" blocks the stack discharge from entering the valley by the same mechanism that prevents the air below it from diffusing upward out of the valley.

The stacks were designed and built of reinforced concrete in accordance with the specifications of the American Concrete Institute. Their inside base diameter is approximately 59 ft at Clifty Creek and 51 ft at Kyger Creek. The top of the foundations in all cases is 152 ft below the breeching inlet. In view of the large space thus provided, it was decided to locate two control rooms and a 250,000-gal condensate storage tank on intermediate floors in each stack.

Coal-handling facilities. All the coal consumed at both generating stations, approximately 7,500,000 tons per year, will be delivered by barge. For unloading the barges at each station, two hoisting towers are being provided, each of which will have a free digging capacity of about 1,200 tons per hour.

After leaving the hoisting tower, coal will be transported by a belt-conveyor system either to the coal bunkers in the power plants or to the yard storage pile. The coal storage to be maintained at the Clifty Creek plant will be 1,300,000 tons, and at the Kyger Creek station 1,100,000 tons, which in each case is about the equivalent of three months' operation. For transporting coal to and from the storage pile, 30-cu yd scrapers pulled by twin tractor units will be employed.

As previously mentioned, large areas have been provided for the disposal of the cinders and fly ash that will be produced at each station. The fly ash and cinders will be transported hydraulically from the plant to these areas, shown in Fig. 4.

Because of the need of carrying on fundamental engineering, economic engineering, legal, and contractual studies in the early days of investigation and negotiation, the job was broken down and assigned to specific groups both within and outside the organizations of the participating companies. Thus the problem of site or sites of power plants, number of units in each plant, the question of transmission, and the coordination of that into an economic study of final cost of energy at the diffusion site, was assigned to a group of Ebasco engineers and analysts working with the American Gas and Electric Service Corp. staff. The question of fuel and fuel supply, so important in the overall economics, including the cost of transportation, was undertaken by the Paul Weir Company.

The problem of organization and the multiplex legalities involved was assigned to a committee of legal representatives from each of the participating companies working with the general counsel of the OVEC enterprise and with the local counsel of prospective participants in the states of Ohio, Indiana, and Kentucky, in which states it became evident early that operations of one kind or another would have to be carried out. The problem of inter-company relationships on interim power, supplemental power, surplus power, and interconnecting facilities, was assigned to a special study group drawn from the engineering and legal staffs of the participating companies.

Following the execution of the power agreement, the services of Ebasco Services, Inc., were retained for special problems. Sargent & Lundy were assigned the commission of designing the Kyger Creek Station, exclusive of the outside electrical facilities, and the design of the inside electrical facilities of the Clifty Creek Station. American Gas and Electric Service Corp. was assigned the commission of designing the Clifty Creek Station, the outside electrical facilities of both stations, and all electrical substation and all transmission facilities.

The construction of the power stations is being handled as follows: On each of the two jobs a small executive staff supervised by the American Gas and Electric Service Corp. is placed at the site. In carrying out the construction, the American Gas and Electric Service Corp. acts, essentially, as the general contractor. The work is executed on the basis of subcontracts entered into either on a unit-price basis in the case of excavation and concrete substructure, superstructure and building work, or on a lump-price basis wherever that is feasible. In the case of some items of erection, such as electrical work, piping, turbine and boiler erection, work will be carried out on a cost-and-incentive-fee basis or in rare cases on a cost-plus-fixed-fee basis. However, every effort has been made to keep such arrangements down to a minimum. Of the unit-price contracts, the largest by far is that covering concrete substructure, superstructure, and building work. In the case of the Kyger Creek plant, this work was awarded to the Booth & Flinn Co. of Pittsburgh, and in the case of the Clifty Creek plant, to the Sollitt Construction Co. of South Bend.

A technical liaison committee, known as the Technical Committee, was set up to discuss problems of mutual interest to AEC, OVEC and their respective engineers, and particularly with the idea of coordinating relaying, metering, and other facilities that were to be installed by OVEC with those installed by AEC at its project. This committee is made up of representatives of the engineers of the participating companies, Sargent & Lundy, AEC, Goodyear Atomic Corp. (operators of the project), and Carbide & Carbon Chemical Corp (consultants to AEC on the project). This has proven a useful and effective instrument in coordinating all the engineering of the huge and complex project.

Looking east across Units 2 and 3 at Clifty Creek site, transformer-bay bracket walls are in foreground, with boiler room and bunker bay beyond. Stack No. 2 and office building are in far background.

A million and a half high-strength bolts speed up steel erection

H. H. NICHOLSON, M. ASCE

General Superintendent, Operations Unit, General Fixed-Price Subcontracts Department, Peter Kiewit Sons' Co., Portsmouth, Ohio

Late in 1952, the Atomic Energy Commission approved a site in Pike County, Ohio, for construction of a $1,219,000,000 gaseous diffusion plant for the manufacture of uranium 235. Early "on-stream" dates required tight construction schedules. The project area of 3,700 acres had to be cleared of farms. Roads, railroads, warehouses, administration buildings, boiler houses, and cafeteria had to be built, and some site grading had to be completed before construction of the permanent buildings could begin.

Most of the buildings are of a standard industrial type with concrete foundations and floors, structural steel frame, cement asbestos siding, and steel deck with built-up roofing. Approximately 100,000 tons of structural steel are required to provide the floor area of 222 acres. This article is limited to the construction of the three process buildings, which contain 79,000 tons of structural steel.

Steel work subcontracted

Fabrication and erection of the structural steel for each of these three buildings was subcontracted to a separate steel company on a fixed-price basis. The steel was fabricated in seven different plants located in the Detroit, Pittsburgh, and East Coast areas. It was shipped to the project site by rail, where 3,300 lin ft of trackage was provided for unloading with cranes, in a storage area of 24 acres, at an average distance of $^3/_4$ mile from the buildings. All steel was placed on dunnage. Rock surfacing along railroads, around the perimeter, and on the cross lanes, gave all-weather access for cranes and trucks.

In these buildings, half a mile in length, a number of the structural members are alike. All companies took advantage of this in fabrication, and shipped quantities of identical members at one time. This required a "shake-out" in the storage yard to obtain the steel to fit erection schedules. Two companies reloaded the steel onto trucks and hauled it to the site as needed.

The third company reloaded on blocking and used two "straddle-trucks" of 45,000-lb capacity to haul the steel. This method is economical, costing as low as 30 cents per ton. However, it requires very careful scheduling in the shakedown yard as the steel is not handled with a crane at the site until erected. Use of the straddle buggies also requires a large shakedown yard and well stabilized surfaced roads. The erection of 300 tons of steel a day in each building required the steel to be rehandled three times, or a daily handling of about 1,000 tons from the railroad to in place.

The tops of the concrete piers are left roughened at $^1/_2$ in. below grade. Steel baseplates are set to grade $\pm$ $^1/_{16}$ in., and grouted. Crews work ahead of the steel erection to check anchor bolts and set base plates.

The large buildings are divided into a number of smaller units by expansion joints. The specifications require that the structural steel frame be erected, pinned, and bolted and then plumbed to a tolerance of minus zero and plus $^3/_8$ in. across the joints. As much as 75,000 lin ft of $^5/_8$-in. cable is used to plumb each building, section by section.

Most floor beams are designed for spiral shear-developers to be welded to the top flange. To avoid difficulty in shipment, all fabricators welded the spirals to the beams in the field, either in the storage yard or after erection. While it is preferable to attach the spirals in the yard, it is not as safe for the erectors.

Permanent field connections of major members may be made either with rivets or with high-strength bolts. The minor-member field connections are made with both rivets and machine bolts. One company elected to use both high-strength bolts and rivets; the other two companies used high-strength bolts and machine bolts, with no field rivets. This afforded an opportunity to compare the merits of riveting and bolting under similar field conditions.

The foundation work proceeded just ahead of the steel erection, and close behind it came the painting, siding, roofing, floor concreting and then the mechanical, electrical, and sheet-metal trades. Between those working ahead and those coming in behind, the steel companies found themselves in the unenviable position of having to occupy the least working space in the building area for the shortest possible time. The sequence of structural work outlined could require one section (about 200 ft) in which a crew checked anchor bolts and set base plates; one section for trucks in which to shake out steel; one section for erection; one section for plumbing the structure; and one section for riveting or bolting. These five sections were reduced by cutting down on the baseplate and shake-out area and using a "stair-step" method of erection, which permitted more cranes to swing in one section. With as many as seven cranes operating in the erection section, full coordination was required to insure maximum use of them all.

The steel companies could be allowed only 6 to 8 weeks in an area for their cycle of work, which required that, once the steel was plumbed and then approved by the architect-engineer, riveting or bolting had to proceed as fast as crews could complete the connections.

Bolts versus rivets

High-strength bolts as substitutes for rivets have been used only within the past seven years. Some companies are reluctant to venture into a large job using only field bolts, but others promote their use.

Field work on the first building required 260,000 rivets and 172,000 high-strength bolts. The steel company used a maximum of 16 riveting gangs, with an average of 11, and for bolting used 16 to 22 gangs. It was noted that the riveting set the pace for completion of the work, because riveters were usually in short supply, although the union cooperated by bringing in crews from all over the United States.

Since this was the first large high-strength-bolt job in the area, it was nec-

AEC—Portsmouth

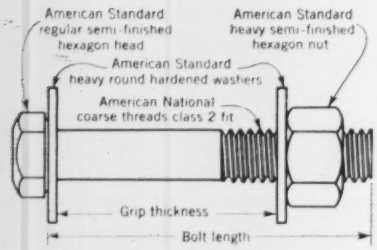
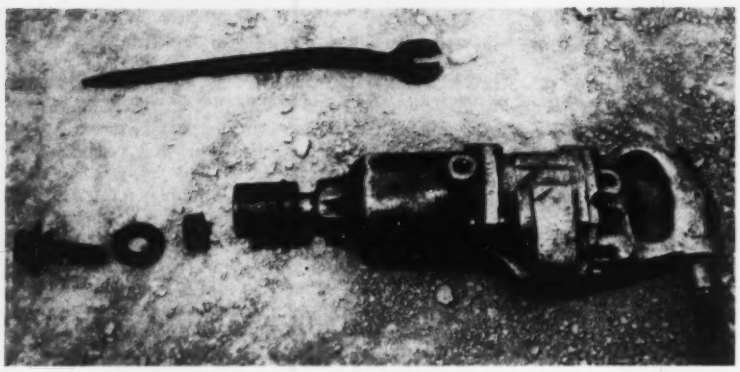


FIG. 1. High-strength bolt assembly consists of bolt, two washers, and nut. Assemblies on this project are made up on ground by crew of four apprentice ironworkers, then placed in metal baskets for hoisting up to placing crews.



Erection tools consist of air-operated impact wrench at right and holding wrench above. Bolt assembly is at left.

essary to establish operational methods and train men in proper use of the equipment. This was done quickly however, and the subsequent jobs, with 1,185,000 high-strength bolts, benefited by it. The methods of the different companies varied in some detail, but their basic operations were the same.

Since with high-strength bolts the joint strength depends entirely on friction, careful attention had to be given to the specification requirement that faying surfaces be free of paint, lacquer, dirt, oil, loose scale, burrs, pits, or other defects that would prevent solid seating of the parts or would interfere with the development of friction. Normal drafting-room procedure and shop practice does not require this, and all steel in the initial shipments had to be reworked in the field. Although this expense was minor, it added to the confusion of getting a job started. Engineers should develop methods utilizing standard shop and field practices in order to solve this problem.

All members when erected have one pin and one or two machine bolts in each connection. The holes should match so that the high-strength bolt will slip in by hand, with clearance all around it. High-strength bolts are not used for erection so as to avoid loss of these more expensive bolts and to eliminate possible damage to the threads that would alter the torque required to tighten the bolts to the proper tension. With six different types of washers required, placing of the proper washer at each connection slowed down steel erection.

After the steel was plumbed, some companies placed the bolts ahead of the tightening gangs and some had the tightening crew place them as they worked the joint. Usually it is preferable and more economical to have the tightening crew place the bolts.

The bolt, washer, and nut assembly (Fig. 1) is made up on the ground by a small crew of four apprentice ironworkers stationed centrally for the bolting work. The various sizes, lengths, and types of bolts, washers, and nuts are brought to the assembly point in unopened kegs plainly marked for inspection. The bolt, nut, and washer material conforms to requirements of the current edition of tentative specifications for quenched and tempered steel bolts and studs, with suitable nuts and plain washers, of the American Society for Testing Materials (ASTM Designation A325). The bolts are regular semi-finished hexagon head; the nuts, heavy hexagon semi-finished; and the washers, heavy, plain (carburized). The bolt heads are marked to denote high strength; the washers are hardened to prevent the bolt from cutting into the softer structural steel; and the nuts are made reversible. Beveled washers are made square for easy recognition.

From a bolt list, a crew makes up assemblies of a bolt, two washers, and a nut and places them in metal baskets for hoisting up to the placing crew. Careful handling of the bolts is very important in order to obtain uniform bolt tension later. Threads should not be rusted or nicked.

The placing crew puts in all the bolts at a joint, except where the pins and erection bolts occur, and tightens them by hand. The two-man tightening crew completes a connection with air impact wrenches by starting at the middle and working outward, or starting at one side and progressing downward and upward. In either case the first bolts will probably have to be retightened. The pins and erection bolts are then replaced with high-strength bolts and tightened, all in accordance with Table I.

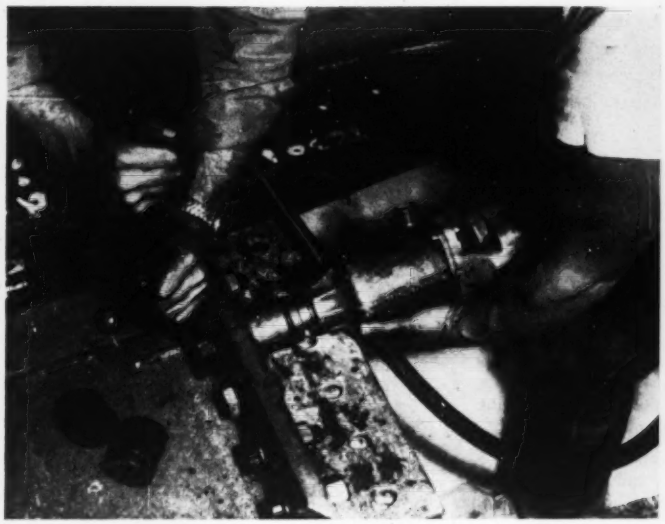
The bolt tightening crews used air impact wrenches, which can be operated by experienced workmen under closely controlled conditions to produce fast, accurate, and economical work. The operating air pressure of 50 to 90 psi is furnished by five or more compressors hav-

TABLE I. Bolt tension and torque values

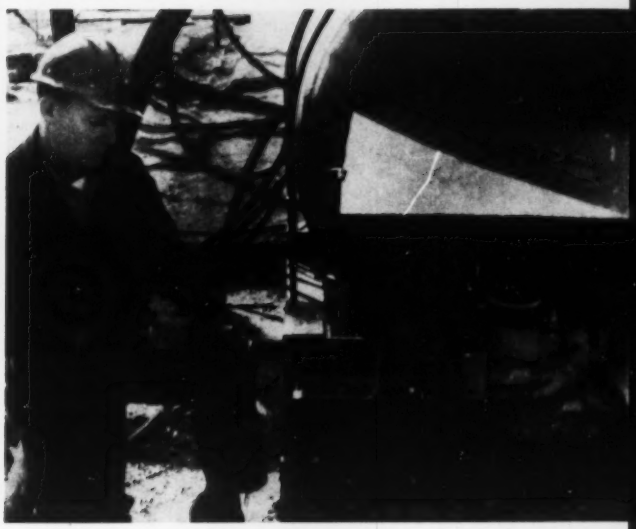
Bolt size, in.	Required Bolt Tension, lb*	Equivalent torque, lb-ft†
5/8	17,300	180
3/4	25,600	320
7/8	32,400	470
1	42,500	710
1 1/8	50,800	960

* Equal to 90 percent of specified minimum elastic proof load of bolt.

† Equal to 0.0167 lb-ft per in. of bolt diameter per lb of tension with non-lubricated bolts and nuts. The values of equivalent torque given here are experimental approximations. The architect-engineer may change the equivalent torque if actual measurements in the field indicate the torque tension ratio to be different from the value given.



Two-man bolt-tightening crew works on girder flange during structural steel erection. Holding wrench is held by man at left while man at right operates air impact wrench.



Impact wrench is held by worker while being calibrated in hydraulic pulling jack frame. Bolt is torqued to wrench stall, and tension in bolt is read directly on gage at right.

ing a total capacity of about 1,300 cfm, working at 100 to 110 psi. The compressed air is delivered to an auxiliary air receiver through a 2-in. hose. Manifolds for distribution of the air supply are located at or near the auxiliary receiver air outlets. Each $^3/_4$-in. diameter take-off from the manifold has a pressure regulating valve coupled with an air-pressure gage close to the outlet side of the valve. The air supply must be adequate to maintain the regulated pressure at all times. One 160-cfm compressor will operate four to six wrenches, depending on size of bolts and type of wrench.

To obtain the proper relationship of air pressure to bolt tension, the air impact wrenches must be calibrated. Devices have been built which are so constructed that when a bolt is inserted and tightened, two plates are pulled together, and the clamping force is measured by electric resistance strain gages or hydraulic pressure, both converted to bolt tension readings. The same length of hose is used in calibrating the wrenches as in tightening the bolts. Since the specifications require that the bolts be tightened to at least 90 percent of the elastic proof load, and the wrenches vary by approximately 15 percent, the wrenches are set somewhat higher than the exact tension required. Wrenches are calibrated before starting work at the beginning of a shift, in midshift, or when the ambient temperature changes radically.

Another method used to check the air wrench is by a manually operated torque wrench. A joint is tightened and immediately checked with the torque wrench. Any required adjustment of air pressure is made and the operation repeated. Either of the above methods can be used, but a combination of both is preferred.

How long an impact wrench must operate on a bolt to obtain the required uniform tension is still a question. The time will vary from 10 to 15 seconds, with stall indicated by a heavier vibration in the wrench and a tendency for the nut-tightening socket to recoil after each impact. Some operators put a series of chalk marks on the outside of the wrench socket and scribe a mark on the steel to check their "feel" of the wrench. A typical bolt-tightening crew consists of two iron workers who take turns in operating the wrench. After the joint is completed, it is marked and is ready for inspection. The impact wrench manufacturers are developing a wrench that can be set to a predetermined shut-off to give the required bolt tension. The value of such a wrench cannot be overemphasized provided it gives consistently accurate results. It would speed up the work and reduce the amount of checking required.

Specifications for bolting

Although an effort is made to closely control all high-strength bolting operations, a final check is necessary to determine compliance with the specifications, which are quoted as follows:

"The proper execution of the bolting operation shall be checked and approved by a procedure of loosening and retightening a certain proportion of the bolts. The proportion to be thus loosened and retightened shall be that amount, as determined by the Architect-Engineer, necessary to show that the results required by these specifications are being obtained. The procedure shall be such as to establish that when the nut is retorqued to its original position, the torque is at least equal to that required by the provisions of Table I hereof. If the retorquing indicates that consistently good quality of workmanship is being obtained, the number of bolts undergoing loosening and retightening will be reduced so that 2 to 5 percent of the bolts placed by each crew need to be tested daily at a time and location designated by the Architect-Engineer; the higher figure being applied to the work of new and less experienced crews of workmen. If the retightening discloses an unusually high frequency of lower than specified torque in initial tightening of bolts in any section of the work, then all bolts thereby suspected of being improperly tightened shall be retightened, to the satisfaction of the Architect-Engineer."

Those charged with inspection should follow close behind the bolt-tightening crews so that both can work together. In that way the workmen will develop the "feel" of their wrench and obtain more uniform bolt tension.

Up to 10 percent of the bolts are checked with a hand-operated torque wrench, and this is varied depending on the experience of the workmen. Most attention is given to new crews and to all work at the start of a shift. Inspection has shown that less than $^1/_2$ of 1

percent of the bolts are off more than ± 10 percent of the set torque value, with most within 5 percent. One crew, on the job nearly a year, has not had a single joint rejected. When the hand torque wrench shows one or two bolts to be off, the joint is marked and all bolts are reworked.

A typical organization for bolting is:

2 foremen
4 ironworkers sorting bolts
24 ironworkers placing and tightening bolts
4 ironworkers checking bolts
2 ironworkers reworking bolts
2 operators for air compressor

The average bolt tightening crew of two men handles 350 bolts per shift, and some get up to 450. A riveting crew of four men averages 175 rivets per shift, with about 15 percent cut-outs. One company contends that if a high-strength bolt can be placed for 20 cents or less, it will offset the lower material cost of the rivet.

Equipment on the job varied, but averaged as follows:

4 cranes in structural steel yard
7 cranes on site unloading and erecting, or 3 cranes when high loaders were used
1 crane on outside building on miscellaneous work
5 trucks hauling steel, or 2 high loaders
15 welding machines
5 air compressors
30 impact wrenches
4 torque wrenches (hand)
1 caterpillar tractor
1 truck, 2-ton
2 pickups

Advantages for and against the use of high-strength bolts are summarized as follows:

In favor of high-strength bolts:

1. On a large job enough riveting crews are not available locally and are difficult to obtain and hold on the job.

2. On-the-job training of ironworkers can develop an expert bolting crew in about 30 days.

3. The impact wrench is light, clean, and easy for either man to operate, so workmen prefer bolting.

4. Pull-up of connection parts into tight contact with machine bolts is not necessary, so only one or two machine bolts are required.

5. With controlled operations, rejection of bolts is very low, usually under $\frac{1}{2}$ of 1 percent, and joints can be reworked without costly removal operations.

6. If erection and plumbing operations get behind, workmen can place high-strength bolts, hand tightened, in connections before steel plumbing is completed, provided the drift pins are left in place.

7. The bolted connection is stronger than the riveted connection, since the clamping force of high-strength bolts is greater, and is constant for all grips of similar-size bolts.

Against high-strength bolts:

1. Extra shop work is required to remove punching upsets and burs on all faying surfaces.

2. Special drafting-room and shop practices are required to avoid shop-painting of faying surfaces.

3. The need of using beveled and clipped washers increases costs.

4. The bolt, washers, and nut as delivered to the job cost about 6 times more than rivets.

5. Dependence on air pressure to control tension in bolts requires careful control and checking, which increases installation costs.

6. Merely to substitute high-strength bolts in a connection designed for rivets does not give any of the economy that might be obtained if the design were originally made with bolts in mind.

With continued research, refinement, in design, and improvement of materials, equipment and methods, the use of high-strength bolts as fasteners will be fairly universal in another five years.

Structural steel erection subcontracts on the process buildings were awarded to R. C. Mahon Co., Detroit, with A. V. Washburn, Superintendent; American Bridge Division of U.S. Steel Corp., Pittsburgh, with A. B. Drilling, Superintendent; and the Bethlehem Steel Co., Pittsburgh, with J. B. Gibson, Superintendent.

High-strength bolt is checked by two-man crew using holding wrench, at left in both views, and torque wrench, at right. Torque required is read in foot-pounds on tension indicator, previously calibrated, clearly seen on torque wrench in close-up.

Precasting procedures made it possible to construct 17 warehouses with storage area of 3,400,000 sq ft, at $5.85 per sq ft. Job-site installations here are believed largest used to date in United States.

JOHN A. DOMINY, M. ASCE
Commander, Civil Engineer Corps, U. S. Navy
CHARLES C. ZOLLMAN, A.M. ASCE
Vacuum Concrete, Inc., Philadelphia, Pa.
HENON PEARCE
Batson-Cook Co., West Point, Ga.

Fast precasting schedule for record-size Marine Corps warehouses

A project of unusual magnitude is the construction of 17 single-story reinforced concrete warehouses with a total net storage area of about 3,400,000 sq ft, recently completed as part of the new Marine Corps Supply Depot at Albany, Ga., being built by the Navy's Bureau of Yards and Docks. This project challenged the ingenuity and imagination of the contractors and called for unusual construction procedures, which brought the cost of these fireproof buildings down to $5.85 per sq ft. Technically sound and economical was the stripping of the rigid-frame side forms two hours after the concrete was poured, and removal of all supports and struts within 24 hours after pouring. Equally successful was the casting of 45,000 precast roof and canopy panels, 5 ft × 18 ft 6 in. in size, at the rate of 272 each working day in only as many forms, and the daily erection with a maximum of two cranes of an average of 250 of these panels, covering an area of about 23,000 sq ft.

Albany, Ga., was selected as the site for the new Marine Corps Supply Depot because of its position as a major rail and highway hub. With connections to seacoast ports extending from Norfolk, Va., down the Atlantic and stretching on the Gulf of Mexico to New Orleans, it has the utmost flexibility as regards routes for shipment, both domestic and overseas.

In June of 1950, Congress appropriated $1,500,000 for the acquisition of real property and for an architectural and engineering contract. In the fall of 1950, such a contract was entered into by the Navy's Bureau of Yards and Docks. Master site planning was initiated in December 1950, and acquisition of approximately 3,700 acres of land comprising the depot proper was begun. In the fall of 1951, Congress appropriated an additional $23,687,200 for construction of depot facilities, and the first construction contracts were awarded in November of that year. The Military Appropriations Bill for the fiscal year 1953 contained an item of $13,687,000 for the Albany depot, bringing the total to nearly $39,000,000. The depot facilities include 17 large general-purpose warehouses (Fig. 1), barracks and mess hall, administration building, main gatehouse, fire station, maintenance and motor-transport shops, along with the essential water, electric and gas distribution systems, roads and drainage systems. The railroad classification yard, in itself a major undertaking, was designed to handle 400 cars, the ladder tracks being set up to handle eight 50-car trains. It is noteworthy that overall depot planning was based on the availability of future congressional appropriations and defense needs.

Each warehouse over 1,000 ft long

Each warehouse is 200 ft wide, 1,026 ft 6 in. long, and has a clear interior height of 21 ft 6 in. Along both sides of each building, for its entire length, run loading platforms 15 ft wide, protected by canopies 17 ft 6 in. wide. The walls are of the built-up cavity type consisting of jumbo bricks and concrete blocks. Four 12-in. fire walls cross each warehouse and divide it into five compartments, each about 200 × 200 ft. All the warehouses are of similar design and construction.

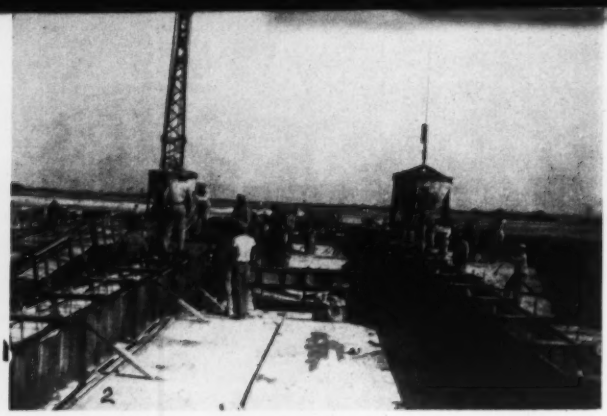
The main structural members are cast-in-place, reinforced-concrete rigid frames 18 ft 6 in. on centers (Fig. 1). The frame columns divide the width of each building into three bays. Each exterior bay spans 64 ft 10 in.; the interior bay spans 70 ft 4 in. Longitudinal struts along the top of the columns brace the rigid frames. At the columns, the minimum clearance is 21 ft 6 in., and at mid-span this clearance is increased to 25 ft 0 in., as the frame is there only 2 ft 4 in. deep.

To complete the warehouse framing, precast thin-shell concrete roof panels, 5 ft wide and 18 ft 6 in. long, span from rigid frame to rigid frame. At a height of 12 ft 8 in. above the loading platforms, which are level with the building floors, canopy panels similar to the roof panels are set on structural steel members, also 18 ft 6 in. on centers.

In terms of cost per square foot of finished warehouse area, including railroad spurs and other appurtenances, a first increment of ten reinforced concrete warehouses was let in early 1952 for $5.85 per sq ft. A second increment of seven reinforced concrete warehouses was let in the fall of 1952 for $5.65 per sq ft. These costs compare well with any other non-fireproof construction material used in warehousing.

To increase competition for the second increment of seven warehouses, additional drawings for an optional roof deck of standard plant-manufactured precast joists and channel slabs were included with the contract drawings. Apparently the excessive handling of small pieces, the many joints to be grouted, the increased problem of alignment,

1. Formwork for daily pour of three rigid frames consists of three timber structures each 46 ft wide, 68 ft long, and 24 ft high.



2. First day, 6 a.m. to 10:30 a.m., daily pour of about 140 cu yd for three frames is completed:

and the multiplicity of tedious operations rendered this design prohibitive, as the contractor chose to cast and erect the base design of long-span thin-shell ribbed panels.

In planning the construction operations, consideration had to be given to the repetitious nature of the various building components. Each building required 330 individual footings to be excavated, formed, and filled with concrete; the setting, moving, and resetting of falsework and formwork for 54 identical rigid frames, each requiring about 40 cu yd of concrete; the casting, handling, and erection of 2,640 roof and canopy panels. By specification, only 340 calendar days were allocated for the completion of the first three warehouses, and a total of 450 calendar days for the completion of seven warehouses of the second increment. To meet this rigid schedule, it was estimated that: (1) three complete rigid frames had to be poured every day for approximately 128 working days, or in about 8 months at 16 working days a month; and (2) 132 roof and canopy panels had to be produced daily for 140 working days, or in about nine months at 16 working days a month. Planning thus became perhaps the most important phase of the entire construction.

For the precast elements, such planning had to include the casting yard layout, sequence of yard casting operations, mold and side-form materials, hauling, and erection procedures. Rolling equipment had to be fitted into this time schedule, with allowances for breakdowns, shortage of manpower on some days, and other contingencies.

Formwork for rigid frames

To meet this schedule, forms for the rigid frames had to be devised that could be moved into new positions easily, that would be reasonable in cost, and that would require a minimum of equipment. A form incorporating three rigid frames in one pour, and capable of being moved on some type of track, was decided on.

Under each of the three frames was placed a steel-angle box-truss spanning from column to column, a distance of approximately 65 ft. These trusses were supported at each end and at the center point by timber bents braced off with each other and the box trusses to prevent lateral movement. Stringers were placed on top of the trusses, to span from one truss to the other, and were to receive the frame bottoms. Between these bottoms a 2-in. tongue-and-groove deck was placed to provide a working area from which to place reinforcing steel, pour concrete, and place the girder side forms. The net result was a steel and timber structure 46 ft wide, 68 ft long, and 24 ft high between columns for each bay, or a total of three movable bridge-like structures to provide form work for one complete daily pour of three rigid frames.

The number of days required to pour, cure, strip, move, reset and repour one group of three frames and connecting struts determined the number of these complete travelers required to maintain the daily schedule of three rigid frames. With standard cylinder and core tests showing that with the combination of high early cement and vacuum processing, 75 percent of the specified design strength could be obtained in 24 hours or less in weather not under 45 deg F, and all shores could be removed under beams and struts within 24 hours. The following sequence for each traveler could be maintained with a staggered crew system:

First day: Pour struts and girders, and remove struts and girder side forms.

Second day: Lower travelers, move them into new position, level and line up, set column steel, and set column forms.

Third day: Complete plumbing of column forms, pour columns, set strut and girder steel, set girder sides and strut forms.

Fourth day: Plumb strut and girder sides, place bolts and inserts, check out for pour.

Fifth day: Repeat operation of first day.

The four-day sequence required only the manufacture of four complete sets of travelers, and the purchase of four sets of steel column forms and of two girder side forms.

Since forms and equipment were available for a pouring sequence of one group of three frames daily, each crew did the same job each day, except that the site of the day's work was on a different traveler. The daily 140-cu yd pour of the rigid frames and connecting struts was started at 6 a.m. and was usually completed by 10:30 a.m. Concrete was supplied from the job-site batching plant and transported in seven 5-cu yd transit-mix trucks. At the completion of the strut pours, a 1 $\frac{1}{2}$-cu yd crane was moved to the traveler on which columns were scheduled to be poured that day, and poured these columns. At the completion of the pour, the $\frac{3}{4}$-cu yd crane used in pouring the girders moved to the location of the previous day's pour and stripped the steel column forms.

At 8 a.m. a crew started stripping the strut side forms and girder side forms in which concrete had been poured only two hours previously. This stripping was normally completed by 1 p.m. The stripping crane then moved to the traveler scheduled to have girder and strut forms set, and placed these side forms until 11:00 p.m. that night. The crane that had started stripping precast panels at 4 a.m. had completed that operation by 11 a.m. and then moved to the building site, where it stripped column forms from the traveler where pouring had been done the previous day.

The entire rigid-frame forming and pouring operation followed mass production principles because of its repetitious nature. The net result of using rigid movable-type forms was that the 378 concrete frames for the seven 200 × 1,026-ft buildings were poured in 7 $\frac{1}{2}$ months, an average of slightly more than one month per building. Very substantial buildings were thus produced.

3. First day, by 1 p.m., all side forms have been removed. Forms and equipment were available for pouring sequence of one group of three frames daily.

4. Second day, by 11 a.m., traveling form has been lowered and moved into new position. Rigid frames poured previous day are self-supporting within 24 hours.

Precast roof and canopy panels

Precast thin-shell roof panels make up the entire 4,000,000 sq ft of roof and canopy deck for the 17 warehouses. The nominal overall dimensions of the basic roof panel are 5 ft × 18 ft 6 in. The basic canopy panel is $7\frac{1}{2}$ in. narrower.

As shown in Fig. 3, the two edge beams of all panels are 8 in. deep and 3 in. wide at the bottom. These edge beams transfer the loads from the $1\frac{1}{4}$-in. thick slab and the five transverse ribs to the rigid frames. The three intermediate ribs are 6 in. deep and 2 in. wide at the bottom. The two end ribs are 6 in. deep and 3 in. wide at the bottom. To facilitate the removal of panels from the molds, all vertical planes of the beams and ribs have a 1:6 batter. The main reinforcing consists of one No. 7 bar in each edge beam with 4 × 4—$^{6}/_{6}$ mesh reinforcing in the $1\frac{1}{4}$-in. slab extending into the edge beams.

The roof panels are set on top of and connected to the rigid frames; the canopy panels are set on top of and connected to the steel beams extending from the outside columns. Each panel required about $^{2}/_{3}$ cu yd of concrete, about 100 lb of reinforcing steel, and about 65 lb of 4 × 4—$^{6}/_{6}$ welded wire mesh. No camber has been provided for deflections in the panels of these seven warehouses.

Molds for the precast concrete thin-shell roof panels were chosen on the basis of the following considerations:

1. Number. The contractors established that the combination of vacuum processing of the concrete and the use of suction lifting devices placed atop a large area, would permit a daily cycle of stripping and pouring. Since each mold could be used once every day, a casting yard of only 140 molds would be required to cast the 26,400 panels for the first increment of 10 warehouses, and one of 132 molds for the 18,480 panels in the 7 warehouses of the second increment.

2. Material. Of all the materials considered, such as lumber, steel, and plastic, concrete appeared best to meet the requirements of ruggedness, in withstanding up to 140 reuses; rigidity, in withstanding deformations; and accuracy in dimensions, to insure perfect alignment. Furthermore concrete molds were leakproof, caused no warping of the precast panels, and required little or no maintenance.

3. Cost. In so far as it has been possible to determine, material and labor costs were approximately $300 per mold, installed in the casting yard. For a panel contact area of 128 sq ft, the cost per sq ft is $2.35. However, these costs should be expressed in terms of formed panel surfaces in view of the large number of reuses. A total of 17,000 sq ft of mold contact area is furnished by 132 molds. This area is used in forming approximately 3,180,000 sq ft of panel contact area for 18,480 panels. This results in the amazingly low cost of $0.013 per sq ft of formed surface. With an actual roof area of 1,700,000 sq ft, the cost would be $0.023 per sq ft. The cost of the edge forms and other yard appurtenances must be added, but the unit cost remains substantially low.

The casting and storage areas were planned and built to reduce to the absolute minimum each and every move in the yards. Production was based on a 24-hour cycle and a single shift per day. With the molds placed in rows of four, a single "stripping" crane proved sufficient for the daily removal of all the 132 panels from the molds. This crane traveled for six successive working days along mold line No. 1 (Fig. 2) and "stripped" the panels for storage and curing in Area A. For the next six successive working days, the crane traveled along mold line No. 4 and removed all the panels from their molds for storage and air curing in Area B.

Concrete was chuted directly into the molds from two 5-cu yd ready-mix concrete trucks traveling along mold lines Nos. 1 and 4. Casting and storage yards were unsheltered except for a shed over the air compressor and the vacuum pump at the end of the casting yard.

Final cost figures for the complete installation of casting and storage yards are not yet available. It is estimated, however, that including labor and materials for the concrete molds and steel edge forms; air and vacuum lines and their appurtenances such as valves, tees and elbows; grading of the entire area and preparation of the soil-cement casting platform; the cost was about $100,000. This is approximately $0.058 per sq ft of actual roof and canopy area.

Casting and storage operations involved nine major operations.

1. Release of side forms. To positively prevent binding between green concrete panels and side forms,

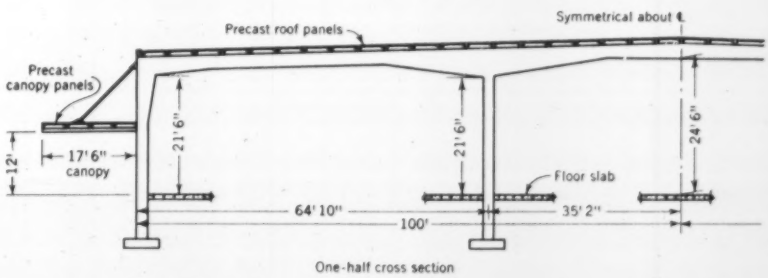
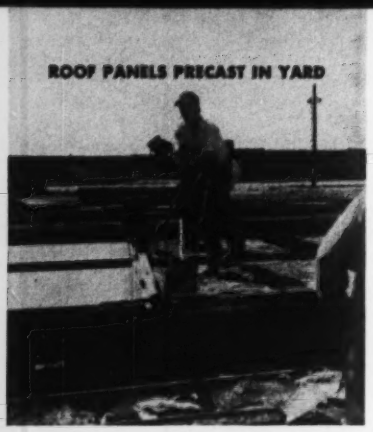
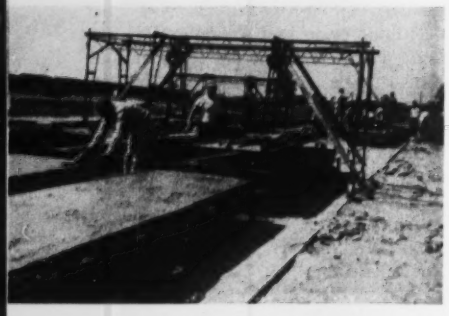


FIG. 1. Warehouse construction is shown in half cross section. Two chief building elements are cast-in-place rigid frames and precast roof panels.



1. After concrete has been chuted direct from truck mixer into molds, screed vibrator moves along top of side forms, spanning two molds.



2. Gantry spanning two molds carries suspended vacuum mats to withdraw excess mixing water. This arrangement was used for second increment of 7 warehouses.

3. Curing compound is sprayed on after concrete is finished.

4. Crane lifts panel held by vacuum and sets it in storage yard. Note safety hooks used during handling and disengaged before setting. Hooks are $2^1/_2$-in.-dia steel bars sliding in greased pipes.

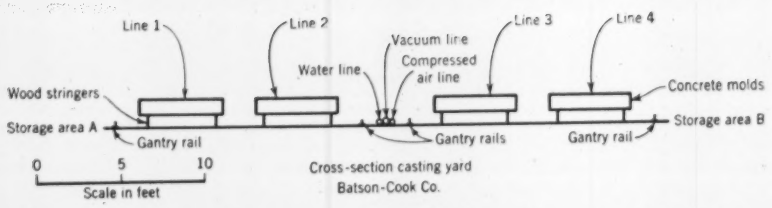


FIG. 2. Cross section shows arrangement of 132-mold casting yard for roof panels for second increment of 7 warehouses.

the forms have to be "removable." To prevent any warping and distortion during a long period of use, these forms have also to be rigid. Furthermore, their design has to permit "...easy and quick release without time-consuming prying; ...resetting to true alignment without undue difficulty; ...maintenance of the close tolerances called for on the contract drawings."

The edge forms with their stiffener, as shown schematically in Fig. 5, were adopted as meeting these requirements. To release the edge forms, laborers walk in front of the stripping crane and, with one mallet blow, remove the pins and pinplates from the latches welded to the steel channels at corners and intermediate points.

2. Stripping and storing panels. A 4-ton crane with a 55-ft boom lowers on the top surface of the panels the panel-long vacuum lifting mat which is connected to a pump mounted on a crane. The vacuum valve is then turned on, and while the lifting lines are strained, compressed air supplied by an air compressor is introduced into the air boxes cast in the concrete molds. The simultaneous action of straining the line and introducing the air causes the panel actually to "pop" out of its mold. Laborers place the safety hooks (steel bars) in greased pipes welded to the stiffening frame of the lifting mat, and the crane operator swings the panel over to the storage area.

Allowing for adjustments in the width of the lifting pans to take care of both roof and canopy panels, the time required for stripping and storing all 132 panels daily was gradually reduced to between $4^1/_2$ and 5 hours. Starting usually at 4 a.m., one crane operator, one oiler, and two riggers completed the entire stripping and storing operation by 10:30 a.m.

3. Cleaning molds, resetting, anti-bond application. The cleaning, setting and oiling crew immediately followed the stripping crew. Jets of compressed air removed any dust and concrete particles remaining in the molds. Edge forms were reset quickly by dropping the pins in the corner latches and driving home the pin plates at the intermediate braces. Thereafter, form oil was sprayed on the concrete mold and steel edge forms as a parting agent to prevent bond.

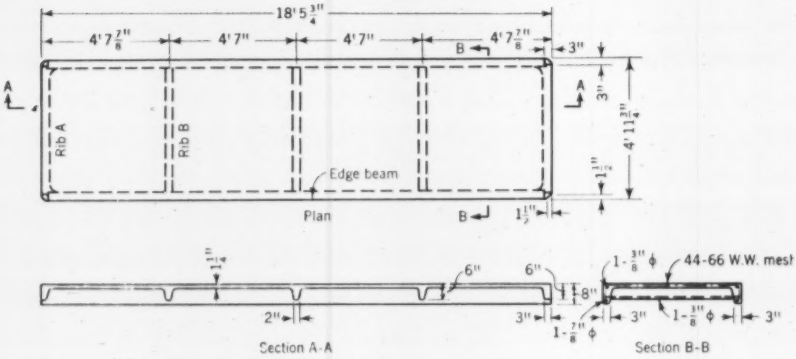


FIG. 3. Typical roof panel is 18 ft 6 in. × 5 ft, and slab is $1^1/_4$ in. thick. Photo at right shows details of steel-channel forms for these roof panels. Air boxes may be seen in upper corner of each form. There are three such boxes in each edge beam. Note also vertical steel bracket with pivoting head (in left foreground) which braces steel channel.

4. Placing of reinforcing. Reinforcing cages were assembled independently for quick and accurate installation in the molds. This operation was carried out in a nearby separate area, where mesh sheets were placed in a specially designed manual press. The bent mesh units were hauled by truck to the casting yard; the previously cut-to-length reinforcing bars were wired to the mesh; and the completed unit was dropped in a matter of minutes into the molds, now ready to receive concrete.

5. Placing of concrete. A 4,000-psi strength at 28 days and a maximum gravel size of $\frac{1}{2}$ in. were specified for all precast concrete work. The following basic mix met the strength requirement: cement factor, 7.25 sacks per cu yd of Type I portland cement; nominal mix by weight, 1:1.95:2.39; water-cement ratio, 5.67 gal per sack; slump, 4 to 6 in.; and vacuum processing. With this basic vacuum treated mix, test cylinders yielded the following average strengths:

Age, days	Compressive Strength, psi	
	Untreated Concrete	Treated Concrete
1	242	828
3	814	2,043
7	1,946	3,891
28	3,117	5,027

Test cylinders were taken daily and cured under the same conditions as the cast concrete. At a field laboratory, 1-, 7-, and 28-day break tests were made. The field compressive strengths obtained varied within a reasonable range.

Concrete was brought from the nearby batching plant in two truck mixers and chuted directly into the molds. The chute extended to the center of the roof-panel mold, where the concrete was deposited in a beam, then raked level by hand. Each batch was sufficient for three pairs of panels. As the casting of the panels progressed, the time required for placing the approximately 95 cu yd required for a day's production was gradually reduced to about $5\frac{1}{2}$ or 5 hours. It would be difficult to better this excellent performance.

6. Vibration, screeding, and vacuum processing. The screed vibrator, a rail 13 ft long, with steel end plates sliding on top of the edgeforms, driven by a one-cylinder engine mounted thereon, vibrated the spaded concrete. At the same time, the excess concrete was stricken off the $1\frac{1}{4}$-in. slab, giving the required uniform slab thickness. The importance of proper vibration in any concrete work cannot be overemphasized. It is more effective and much better controlled in a casting yard at ground level than on scaffolds on cast-in-place structures. If a honeycombed surface does appear in precast work, the relatively inexpensive precast unit can be discarded, and corrective measures can be taken before the job has progressed too far.

After striking to a finish, the top surfaces of the panels were vacuum treated with panel-size mats, suspended from rolling gantries. After treating the top surfaces of the panels for about 5 minutes, the gantries were rolled to the next row of molds.

7. Curing. Standard specifications call for the customary water curing or membrane curing compound. The exposed portion, or top of the roof and canopy panel, was sprayed with a residual wax type of curing compound. This application of the curing compound immediately followed the finishing operation.

8. Removal of spilled concrete. Excess concrete spilled over the edge forms during screeding had to be removed daily before it had set or it would have interfered with the release of the edge forms and prevented access to vacuum and air lines. With concrete placement requiring less than 6 hours, laborers were available for removal of spilled concrete within the 8-hour period.

9. Washing and cleaning equipment. With the repeated daily use of all equipment, the importance of keeping it in good condition is evident. Operations were therefore completed by scrubbing the vacuum mats and washing all equipment.

A standard lumber carrier hauled the panels from the storage yards to the erection site, an average distance of a half mile. Driven over the panels stacked six high, the carrier shoes moved inward under the panel edge beams and hoisted the entire stack. With three round trips an hour, 140 panels (13,500 sq ft) could be loaded, hauled, and unloaded daily by one driver.

It was found expedient to use a second lumber carrier at the erection site to distribute the panels along the 200-ft frame. The boom of the crane moving in the adjacent bay reached over the top of the bent, and set up to 140 roof panels daily with the vacuum lifter. In addition to crane operator and oiler, one rigger worked at ground level, and two riggers at roof level. Erection and connection of the panels to the frames presented no problem, as the $\frac{3}{8}$-in. tolerance in the overall dimensions of the panels proved more than sufficient.

Largest job to date

It is believed that the rigid frames, casting and storage yards used on this work are the largest job-site installations built to date in the United States. Each casting and storage yard occupies an area of approximately 1,000 × 180 ft, or 180,000 sq ft. For both general contractors, these projects were their first experience in thin-shell ribbed precast concrete work, and in mass production techniques applied to civil engineering. As a result of careful planning, the first contractor broke in his crew and attained full production in the remarkably short time of 7 operational days, reaching the goal of 140 daily panels on the seventh day. It should be noted that while heavy rains caused stoppage of all cast-in-place concrete work, operations in the casting yard continued without interruption.

The second contractor installed his casting yard under adverse conditions during the particularly bad winter season of 1952. Fifty-five calendar days later, the entire 132-mold casting and storage yards were ready to function, and the first roof panel was poured, stripped, and stored.

From the start, the various casting and storage operations dovetailed almost perfectly. All the various daily operations were carried out in the casting yard and at the erection site well within the anticipated daily time period, and with less labor and less equipment than had been originally contemplated. At times, the casting yard has had to be shut down when panels could not be moved from the storage yard for erection because the cast-in-place concrete warehouse frames were not ready to receive the panels.

Success due to cooperation

Two of the reasons why both of the general contractors, though inexperienced in thin-shell construction, were able to perform a remarkable job at low cost were: (1) the designer's awareness that, for a structural element to be sound and economical, he must thoroughly understand the builder's problems; and (2) the close cooperation between the engineering forces of the Bureau of Yards and Docks and the contractors. The general contractor is in full control of each and every phase of the work and can exercise his ingenuity to develop at will innumerable "slick" devices. This combination of close cooperation between the design engineer and the contractor, and the contractor's freedom of action in precast work results in the same economies in the construction field which in industry have been attained through a combination of design engineering and production.

Design and construction of the entire project for the United States Marine Corps were instituted and administered by the Navy's Bureau of Yards and Docks, with Rear Admiral J. F. Jelley, CEC, USN, M. ASCE, then Chief of Bureau and Chief of Navy Civil Engineers. Captain W. T. Eckberg, CEC, USN, and his successor Captain S. P. Zola, CEC, USN, District Public Works Officers, Sixth Naval District, were Officers in Charge of Construction, and Commander J. A. Dominy, CEC, USN, M. ASCE, was the Resident Officer directly in charge of the design and construction of the project at the site.

The Bafson-Cook Company of West Point, Ga., and an associated group consisting of Grannis & Sloan, Thompson & Street, and Wattinger, of Charlotte, N.C., and Richmond, Va., were the general contractors for the warehouses. The respective project managers for these firms were H. W. Pearce and Jos. Padgett. Planning of the casting yards and casting procedures for the thin-shell precast concrete roof panels was accomplished in conjunction with the general contractors by Vacuum Concrete, Inc., of Philadelphia, Pa., with K. P. Billner, President. The project was handled for Vacuum Concrete, Inc., by C. C. Zollman, A.M. ASCE, Chief Engineer.

Site planning and design of the project were accomplished under a Bureau of Yards and Docks Architectural and Engineering Contract with Dunwody-MacEwen, Hall & Ferguson, Architects, of Macon, Ga., associated with the J. E. Greiner Company, Engineers, of Baltimore, Md.

EJC geared for fast action

Prepared by instruction of the ASCE Board of Direction by a Special Committee composed of the 1954 ASCE delegates to EJC: Carlton S. Proctor, Chairman, Walter L. Huber, G. Brooks Earnest, and W. N. Carey

A recommendation of far-reaching importance was made early in 1952 to fifteen national engineering societies by a group known as the "Engineering Societies Exploratory Group." The recommendation in its essence was that the engineers of the United States form what was called a "unity organization" using EJC, as constituted in 1952, as the foundation and basic pattern for the new national organization. The ASCE Board of Direction, the men the individual members of the Society elect to represent them, adopted the recommendation of the Exploratory Group. It should be of interest to know what EJC was in 1952, how it was developed to that point; also what was the Engineering Societies Exploratory Group, and how it got into the deliberations.

For the past half century and more, engineers have favored some kind of a single organization to give more unity and solidarity to the profession. A few notable but unsuccessful tries have been made to that end. The engineers who, in 1939 and 1940, formed the committee which later grew into EJC, probably had no thought that it might be developed into the national unity organization for the engineering profession. This development came gradually and naturally in response to need and demand. It took five years or more after its start for EJC to develop clear form and purpose. This, in contrast to the organization of its one important predecessor, the American Engineering Council of the Federated American Engineering Societies, known as AEC.

Unity and the American Engineering Council

There was need for a national unity organization for engineers right after World War I, at the beginning of a tremendous industrial upsurge throughout the country. To meet that need, AEC was established in 1920 at the instigation of the then Secretary of Commerce, Herbert Hoover. It was sponsored by two of the four "Founder Societies" and certain other engineer groups. The council of AEC was composed of representatives appointed by the member societies of the federation on the basis of one member of the council for each thousand members of each respective society. There was no requirement that AEC delegates be members or former members of the governing bodies of their

societies. This fact proved to be the major cause of the eventual breakup of AEC.

With members of the council of AEC often knowing little of the current policies of their respective societies and, in later years, apparently caring less, the AEC federation gradually left the control of the governing bodies of the societies which fathered and supported it. Dissentions between the societies and the council occurred. Support gradually was withdrawn and AEC broke up in 1940. At its high water mark the AEC federation consisted of 54 societies: 8 national, 18 state and 28 local. During the nearly twenty years of its existence, AEC made many worthwhile contributions to the national welfare and to the engineering profession. But for the earlier mentioned fatal defect in the design of its organization, AEC and not EJC probably would be our national unity organization today.

Early development of EJC

EJC really had its beginnings in 1917, three years before AEC was established. In response to requests by national officials in 1917, the four "Founder Societies," ASCE, AIME, ASME and AIEE, formed the Engineering Council of the National Technical Societies of America. This early Council, using both society and government funds, worked through special committees toward the solution of engineering problems involved in the development of the automobile, truck, tank, airplane, etc., for national defense. When AEC was formed in 1920, this original Council turned over its operations to AEC, but the close relationships which had been established among the secretaries of the four societies was continued through an informal "Secretaries Committee."

When intensive preparations for World War II were being made in 1939 and 1940, government officials again sought help from the national engineering societies on certain problems. AEC was then about dead and distinctly persona non grata to the national administration. Government inquiries and inquirers came to the Founder Societies through a group named the Engineers National Defense Board. The Board was formed at government suggestion and was composed of the presidents and secretaries of the four societies plus five additional and specially qualified engineer appointees. The work of the Engineers National Defense Board was an extremely valuable contribution by the engineering profession to the preparedness program. The desire to perpetuate an engineering group capable of rendering service to the country at any time inspired the creation of EJC in 1941. As instituted, EJC, then known as Engineers Joint Conference, consisted of the presidents and the secretaries of the original four societies, to which in 1942 the American Institute of Chemical Engineers was added.

All during World War II, the help of Engineers Joint Conference was frequently requested by the government and always given on many vital matters concerned with what became known as "an engineers' war." The record of World War II service rendered to the nation by Engineers Joint Conference will make a proud story when told, but this is not the place for it. In the many meetings of Engineers Joint Conference during that period, matters of society concern such as national legislation, professional problems, and technological developments quite naturally came before the group for discussion, and for either prompt decision or referral to the societies. This trend and the end of the war in 1945 prompted an expansion in the original functions of Engineers Joint Conference, in the number of representatives from each society from two to three, the adoption of a formal but brief constitution, and a change of name to Engineers Joint Council.

Outstanding accomplishments, 1945–1953

The necessity for and the value of EJC from the viewpoint of both the public welfare and the engineering profession is attested by what it has accomplished. A few of these accomplishments are described below as typical examples of what can be done through EJC.

National Science Foundation. When the original legislation to authorize National Science Foundation was first placed before Congress, neither engineering research nor engineers were mentioned. Effective representation to Congress by a panel appointed by EJC, with an ASEE delegate added, finally resulted in engineering research being named as one of the objectives of the legislation which was enacted. The EJC Committee on Engineering Science now cooperates with the National Science Foundation in initiating and developing basic research in the engineering sciences. Another similar EJC committee is cooperating on the development of the engineering section of the National Scientific Register.

Taft-Hartley Act. Most engineers now know of the "professional employee" provisions in the National Labor Relations Act, the Taft-Hartley Act. Many engineers do not know that those provisions went into the legislation solely through the efforts of the EJC Labor Legislation Panel. On EJC invitation the panel was strengthened by the addition of representatives of ASEE and NSPE. The professional employee provisions of the Act give statutory protection to engineers against being forced against their will to join labor unions. At the same time, the law protects the right of engineer employees who wish to form collective bargaining units exclusively of engineers.

Employment Conditions Activities. Under a Committee on Employment Conditions, EJC is promoting through its constituent societies the circulation of questionnaire surveys to determine the basic facts concerning engineers with relation to labor unions and related matters. The results of these surveys, when assembled, correlated and published by EJC, will give the profession the first reliable and comprehensive statistics covering the status of the engineering profession as related to this subject.

U. S. Civil Service. For years, engineers have believed in the wisdom of a committee of engineers advisory to the U. S. Civil Service Commission. As a result of long negotiations by EJC, such a committee was appointed by the Commission. In its advisory capacity, this committee renders valuable service to the profession toward correcting certain inequities which have developed as to U. S. Civil Service engineer employees, their classifications and salaries.

Army Reorganization Legislation. A few years ago a segment of the U. S. Army brass apparently decided to give the technical, scientific and professional services of the Army a very fast shuffle—medics and lawyers excepted, of course. Legislation was prepared in one of the General Staff units. It contained provisions which would have left the Corps of Engineers and other professional corps such as Ordnance, Chemical and Signal without statutory guarantee of professional status. Engineering was given no recognition as a profession. In fact, except for the medical services, the attorney general's department and chaplains, the legislation provided that all Army officers in all

but those branches were to be one hundred percent interchangeable.

This remarkable piece of legislation was kept extremely quiet until it was introduced under the sponsorship of the Army General Staff. EJC reacted quickly with a task committee headed by C. S. Proctor of ASCE. As a result, the record of Congressional hearings on this matter shows that the Army Chief of Staff, earlier a proponent of the legislation, proposed two amendments which, he said, "Mr. Carlton S. Proctor of Engineers Joint Council, on behalf of that organization, suggested." The essence of the principal amendment recommended and as finally passed by the Congress provides that:

"officers of the Army assigned to technical, scientific, or other professional duties shall possess qualifications suitable for the performance of those duties; and, when the duties involve the performance of professional work the same as or similar to that usually performed in civil life by members of a learned profession, such as engineering, law, medicine, or theology, they shall, unless the exigencies of the situation prevent, possess, by education, training, or experience, qualifications equal or similar to those usually required of members of that profession."

It is believed that this is the first time engineering has been classified specifically in national law as one of the learned professions.

Industrial Disarmament Reports. Among the early accomplishments of EJC were the two classic engineering reports, on the Industrial Disarmament of Germany and on the Industrial Disarmament of Japan. Under the direction of the EJC National Engineers Committee, well informed engineer leaders in industry developed two detailed and common sense reports which many of our military leaders profusely praised. The press, too, took notice in its news columns and editorials. In an editorial, the *New York Times* referred to Engineers Joint Council as an important "national resource" hitherto not sufficiently used.

Engineering Profession in Transition. A statistical milestone marking progress of the engineering profession in the United States was set in 1946 by a special EJC Task Committee in developing and publishing a rather ponderous document entitled "The Engineering Profession in Transition." With the cooperation of the U. S. Bureau of Labor Statistics and the services of an expert in the statistical field, EJC produced one of the most complete statistical records ever produced in America on members of the engineering profession, their education, earnings and work.

National Water Policy Statement. Perhaps the outstanding EJC accomplishment of 1950 was the publication of a "Statement of Desirable Policy with Respect to the Conservation, Development and Use of the National Water Resources." Culminating two years of study by the EJC Water Policy Panel, the statement was the result of the voluntary contribution of time and ability of 80 outstanding members of the profession. Generally acclaimed as a statesman-like document, it sets forth in frank terms a critical appraisal of practices in respect to development of the country's water resources and recommends principles on which a sound over-all policy should be based. This publication was put in the hands of every member of Congress and currently has been made available to appropriate committees of the "Hoover Commission" for use in present studies of the subject.

EJC Manpower Commission. The EJC Manpower Commission has been in operation about three years. It has continuously participated in national planning for national mobilization with emphasis on the importance of engineers to the national economy, and particularly with regard to the utilization of specialized personnel. It is believed that the EJC Manpower Commission has been successful in arousing in the Congress and in the Department of Defense an awareness and an understanding of the over-all national scarcity and value of engineers and scientists in national defense.

Recent EJC developments

The work being done by EJC in its first few years did not go unnoticed among certain state and local groups of engineers. Suggestions were made by several such organizations to the effect that EJC be reorganized so that appropriate state and local engineering organizations could become part of EJC. A special committee appointed by EJC reported on the subject in 1946 and 1947 but the effort was generally unproductive. Requests and suggestions to expand EJC continued to be received. The motivation for these requests appeared to be a desire to permit state and local groups broadly representative of the engineering profession to organize for operations at state and local level along lines similar to EJC operations at national and international level.

These pressures on EJC resulted in an invitation from the President of EJC (then R. E. Dougherty, Past President of ASCE) to 15 national engineering societies to form an exploratory conference for the purpose of exploring the desirability and practicability of measures which would increase unity of the profession. The invitation was issued in June 1949 and went to all U. S. national engineering societies with a membership of 5,000 or more. The Exploratory Group met, elected its own officers and appointed its own task committees. It was in no way an EJC organization but a completely independent study group made up of delegates appointed by 15 national engineering societies, among which were the four "Founder Societies" and the AIChE.

By December 1950, the Exploratory Group had developed for discussion purposes a report presenting four different plans for a unity organization. The report was distributed widely among the members of the constituent societies. The officers and the Local Sections of ASCE were requested to study it carefully. In most cases they did so either directly or through special committees. Comments and view of individuals and Local Sections were transmitted to Society Headquarters.

The four plans presented to the 15 societies for study were based on a resolution earlier adopted by the Exploratory Group. The resolution expressed the conclusions that:

1. It is desirable that the engineering profession establish a unity organization;
2. Such unity organization should be formed by the modification and development of a present organization or the integration of two or more present organizations;
3. The unity organization should initially include participation of a majority of the national societies in the Exploratory Group;
4. In order to avoid the conflict of disagreements as to form and activities of the unity organization, that organization should be launched in the simplest possible way so that questions as to subsequent details and determinations may be studied by the organization itself, rather than through further study by the Exploratory Group.

By December 1951, the Exploratory Group had considered the reactions reported by the participating 15 societies relative to the four possible plans reported out in December 1950. Based on these reactions and on further discussion in the Exploratory Group, the plan known as "Plan A" was recommended to EJC. Rep-

resentatives of one (NSPE) of the Exploratory Group of 15 societies dissented. The plan recommended contemplated change and expansion of EJC to include all of the fifteen societies of the Exploratory Group into one unity organization of engineers. The recommended plan also indicated that participation of state and local engineering groups in EJC in some manner was properly the problem of the reconstituted EJC, if and when that might occur.

The final recommendation of the Exploratory Group was received in January 1952 by EJC. Since it involved a radical change in EJC organization and policy, the recommendation was submitted for approval by each EJC society. During 1952 these approvals were given together with required basic changes in the EJC constitution. The Exploratory Group societies which were not already in EJC were invited to join under the new constitution so that all might work together for the development of the engineering unity organization the profession had long sought.

By January 1954 three of these societies had become part of the newly constituted EJC and with the original five, are sharing the work of redesigning the organization. These three are the American Waterworks Association (AWWA), the Society of Naval Architects and Marine Engineers (SNAME) and the American Society for Engineering Education (ASEE). With these additions, the total membership of the societies now federated in EJC is in excess of 170,000 (March 1, 1954) not counting student members. The original invitations by EJC to the Exploratory Group societies to come into EJC and help rebuild it toward the accepted objective expired December 31, 1953. A request from any of these societies to join EJC will be considered by that body at any time.

It is of passing interest to note that one of the Exploratory Group societies, NSPE, gave lengthy consideration to the EJC invitation but finally rejected it, at least, "at this time," to quote from the resolution of declination. In connection with the study made, a special joint committee of three members of EJC with three members of NSPE gave particular attention to the matter. This joint endeavor did much to further a better understanding between the two organizations It is encouraging to note that this joint committee remains in existence for the purpose of exploring future areas of cooperation between the two organizations.

Present framework and purposes

The present Council is composed of 19 representatives of the eight constituent societies, the representatives being appointed by the respective governing bodies in proportion to the membership of the member societies. Representatives or delegates on the Council, when appointed, must be members of the governing boards or officers of the societies which they represent. Appointments are for one-year terms. Provision for alternate representatives is made at the same time the representatives are appointed. The presidents of the constituent societies are ex-officio members of the Council. The President and Vice-President of EJC and the members of an eight-man Executive Committee are elected at the Annual Organizational Meeting from among the EJC representatives, one from each society and each to serve for one year. The EJC Constitution provides that the President, the Vice-President, and the other members of the Executive Committee must each be from a different society.

The objects of EJC as expressed in its constitution are:

1. To advance the general welfare of mankind through the available resources and the creative ability of the engineering profession.
2. To promote cooperation among the various branches of the engineering profession.
3. To advance the science and the profession of engineering.
4. To develop sound public policies respecting national and international affairs wherein the engineering profession can be helpful through the services of the members of the engineering profession.

As before stated, there is a total of over 170,000 members in the eight societies which make up the EJC federation at present. The total 1954 budget of these societies is just a little under five and a half million dollars. The amount contributed by the EJC societies for operation of EJC and its activities varies from year to year. The average of such annual total contribution for the past five years, 1950 to 1954 inclusive, is $14,600. On the present basis of total membership, this is an average of less than a dime per member.

The membership of the federated societies is distributed throughout the country, and there is a small percentage of foreign members. There are about 500 local sections, chapters or branches of these societies, with one or more local groups in every city and town of importance in the nation. Through the local units of the EJC societies any question of national interest to engineers can be transmitted through a constituent society to EJC for joint action. The governing boards of the societies can transmit directly. Examples of results of such procedure in missions accomplished already have been given.

Quick action possible

Misinformation apparently prevails as to the alleged slowness of EJC operations. The fact is that EJC is geared for extremely fast action, if required, on most of the proposals likely to come before it. Inherent in this advantage is the provision that the representatives forming the Council must be members of the governing boards or officers of the respective EJC societies. These men know the current policies of their boards of direction because they are part of those bodies. They know what actions are safe for them to take in EJC decisions within the limits of their own society policies. In an emergency, the EJC Executive Committee can act for EJC. Similarly the executive committees of the several societies of the federation usually can act for their governing boards.

There are few questions of national import affecting engineers which cannot be acted upon within the limits of well established policies of the participating societies. When an emergency question requiring referral arises, a decision by the respective societies usually can be obtained as fast as the secretaries of the societies can contact the members of their executive committees by long-distance telephone and transmit the committee decision to their EJC representatives or to their representatives on the EJC Executive Committee. Normally, such fast action is not required. The Executive Committee of EJC meets at least once every month, and the full Council at least once every other month. Because of the frequency of these meetings it is rare that EJC is caught with an emergency situation requiring emergency treatment. However, it is a procedure which has been used and which can be used whenever required.

Perhaps the best general view of EJC as presently constituted and operated can be obtained through a reading of its 1953 Annual Report [obtainable on request from the Secretary of EJC, 29 West 39th Street, New York 18, N.Y.] The report of the President of EJC, which begins on page 1, is particularly worth the attention of every engineer who has the welfare of his profession at heart

Water—a critical material

WITH our constantly rising standard of living and the increasing per capita consumption of raw materials, we may expect the nation's water requirements to double again between 1950 and 1975. In fact, water supply may become the most important factor affecting industrial location.

—G. A. H.

Next to the air we breathe, water is the most essential single material we use. It directly sustains all plant and animal life and is hardly less important in many other uses. Water is the most efficient media for the transfer of heat and energy, both solar and man controlled, and is universally used as a solvent and cleanser. In the stream-channel phase of the hydrologic cycle, water provides the cheapest transportation for bulk commodities as well as a vehicle for the disposition of most man-made wastes.

The unique properties of water which permit changes from a liquid to a vapor or solid, or vice versa, are being constantly utilized to promote man's comfort and well being. The ancient Hindus and Egyptians utilized water for irrigation purposes some 5,000 years ago when living was much simpler than it is today. The importance of water in our present-day economy has increased many fold, and as the demand approaches the maximum available supply, water may become one of our most critical materials.

We have much to learn about the hydrologic cycle whereby the sun extracts each day some 4,300 billion gal of pure water from the oceans in the form of vapor and distributes it over the land mass of the United States. This volume would be sufficient to cover 132,000 acres with 100 ft of water. We know very little of the processes whereby the sun's energy transforms ocean water into fresh vapor, and it is only within the past decade that we have started to assemble more precise information on the route these clouds of vapor take in their complex travel over the earth. There is much to be learned about the condensation of these clouds into raindrops as well as about the infiltration of water into the earth, surface runoff, evapo-transpiration, erosion, sedimentation, ground-water recharge and discharge, salt-water intrusion, chemical changes, and many other physical processes that affect our water supply.

Speaking of chemical changes for example, innumerable naturally occurring compounds are dissolved in the raindrop as it travels over and through the earth to the sea. The amount of earth salts that are dissolved in the river water of this country annually has been estimated at 5 billion tons. Mention should also be made of the fact that, because of our current practices in disposing of sanitary wastes and with the growth and intensification of industry, the raindrop during its travel is exposed to many man-made compounds.

Cyclic floods and droughts

In addition to the short-time cyclic changes that produce droughts and years of abnormal flood runoff, there are long-range climatic changes. Ample evidence is available that our climate has varied many times in geologic history. According to Lougge, an eminent geologist and geographer, during the last glacial climax the ice cap in the Hudson Bay region was about 20,250 ft, or 3.8 miles, thick at its center. He estimates that this superimposed load depressed the earth's surface in that area some 2,500 ft below existing levels and that a depression in excess of 500 ft still exists. The surface of the earth's crust previously covered by glaciers is still undergoing readjustment. For example, accurate records of levels maintained in the Great Lakes region for many years show that the level of the area controlling the outflow from Lake Ontario is changing at the rate of from 0.4 to 0.5 ft every 100 years. A similar situation exists on Lake Superior, where the elevation of the docks and grain elevators in the vicinity of Duluth, Minn., is dropping with respect to the average level of the lake. The glaciated section of North America is not the only region undergoing readjustment. It has been estimated that a large part of The Netherlands, now some 10 ft below sea level, is sinking at an average rate of 6 in. every 100 years.

Because of the storage of such a tremendous volume of water in the form of glacial ice, during the last glacial climax the sea was some 300 ft below its present level. There are indications that the level of the sea is still rising, which may pose serious problems for future generations.

Although there appears to be plenty of evidence for determining the climatic changes that have occurred in the past, we do not seem to be able to predict current weather changes accurately more than a few hours or days in the future. A better understanding of the forces of the universe possibly might solve some of our weightiest problems in climate and water supply.

The average annual precipitation in the United States is about 30 in., of which 70 percent returns to the atmosphere by evaporation or transpiration from growing vegetation. This leaves a water yield of about 8 $\frac{1}{2}$ in. This yield is available in streams and through wells tapping underground storage areas but is not distributed uniformly over the United States; in fact, some of our greatest problems are due to maldistribution of water supply as to both time and geographic area. For example, 17 western states constitute about 60 percent of the land area of the United States but receive only 25 percent of the nation's water supply. Runoff in these 17 western states averages less than 4 in. On the other hand, the runoff in 31 of our eastern states averages about 16 in. There is a great variation in runoff between states as well as between sections of states.

Ground-water supplies also vary greatly throughout the United States. This important resource serves two functions in supplying the nation with water—direct feeding of innumerable wells, and the regulation and equalization of stream flow. The effect of ground water on the flow of streams varies from the almost 100-percent regulation afforded the Niabrara River by the sand hills of northern Nebraska to the flow through the porous mantle of some of the forest-covered areas in New England, where the water from heavy rains infiltrates into the surface humus and soils but reappears in the stream channels within a short time. It has been estimated that from 35 to 40 percent of the total flow of our streams has passed through the earth's porous mantle.

A review of engineering literature indicates that in 1900 we withdrew from our streams and wells about 500 to 600 gal per day per capita. By 1950 the population of the United States had doubled and the use of water had increased to 1,100 gal per day per capita. In other words, the rate of withdrawals over that fifty-year period had quadrupled. The total withdrawal of fresh water in 1950 amounted to one-eighth of the total yield of the nation's streams and aquifers, or 170 billion gal per day, enough to cover 5,220 acres with 100 ft of water daily. A substantial part of this total withdrawal is returned to the

GAIL A. HATHAWAY, Past President ASCE

Special Assistant to Chief of Engineers

U.S. Army, Washington, D.C.

ALTHOUGH good progress is being made in cleaning up our streams, their wide use over the past few decades as carriers of raw sewage and industrial wastes will have an adverse effect on the underlying aquifers. Pollution in the streams may be removed in a short time, but the pollution of aquifers may not be removed in decades.—G. A. H.

streams, and in many cases there is considerable reuse. Possibly 60 percent of the total withdrawal is returned to the streams as waste.

Industrial withdrawal heavy

In 1950, direct withdrawal of water by industrial firms was about 80 billion gal per day, of which 65 billion gal was fresh water and 15 billion gal was obtained from brackish or salty sources. Over 40 percent of the industrial requirements was used for cooling and condensing purposes in steam-electric generating plants. There are roughly 250,000 industrial plants in the United States but the bulk of the water is used by a relatively few large industries. One steel mill may require 500 million gal per day, enough for a city of several million population. It takes over 18 bbl of water to make 1 bbl of oil, 65,000 gal of water to make 1 ton of steel, and 64,000 gal to make 1 ton of sulfate paper. The manufacturing of synthetic materials such as rayon and nylon requires much more water for processing than did the natural materials, cotton and wool, which are being displaced at least in part. Each additional stage in the oil refining process requires much more water than earlier and more simple stages. Synthetic rubber production requires large quantities of water not needed in the production of natural rubber. Thus technological advances aggravate rather than alleviate industrial water problems.

By far the greatest use of fresh water is for irrigation. In 1950, 26 million acres of irrigated land received about 50 percent of all fresh-water withdrawals in the United States. It is estimated that irrigation accounts for over 80 percent of the total consumptive depletion of all water uses. Although irrigation has previously been confined mostly to the West, large areas of land in the East are now being subjected to supplemental irrigation in order to increase crop yields.

Approximately 18 percent of the withdrawals of fresh water for irrigation is obtained from wells, some with artesian flow but most pumped. In California alone, the gross total pumpage in 1950 was 10 million acre-ft, which is about 40 percent of the total pumpage in the United States.

The most critical unsolved problems are in the Southwest, from west Texas to Southern California. The annual runoff of streams in this region is only a fraction of an inch, notwithstanding the fact that the soils are very fertile and the controlling factors affecting the growth of crops, such as the lack of killing frosts and the number of days of sunshine, are extremely favorable. Ground water is at a premium in this critical area, as 50 percent of the fresh-water withdrawal is from wells. In fact, the area uses as much ground water as do all other sections of the country combined.

The excessive withdrawal of ground water is exemplified by the high plains area of west Texas, where about 1.4 billion gal per day was pumped in 1950 from 14,000 wells. This rate of withdrawal is from 20 to 30 times the rate of replenishment. There is no alternative source of water; therefore, as present ground-water storage is exhausted, irrigation will decline. Probably the best example of the critical water problems in the Southwest is in the state of Arizona, which has a total water yield of only 0.7 of an inch but in 1950 the water withdrawals were about 0.9 of an inch. Water use thus exceeds the available supply on a long-time basis.

The water that is not withdrawn from the streams and lakes in the United States serves many useful purposes. Seven times as much water was used for the generation of hydro power in 1950 as was withdrawn for use. Our inland waterways, exclusive of the Great Lakes, in 1950 provided transport for over 51 billion ton-miles of domestic freight. Commercial and sport fishing in inland streams is a major industry and the use of our streams for recreational purposes is increasing each year.

Water pollution, a national problem

Water pollution is a nation-wide problem. Stream pollution is closely associated with the density of population and industrial concentration. However, it is also related to quantity and regularity of stream flow. According to the Public Health Service, there are some 22,000 major sources of pollution in the United States, and to clean them up, say within 10 years, would cost from 9 to 12 billion dollars, of which 4.5 billion dollars would be required for municipal facilities.

One of the major sources of pollution is the dumping of raw sewage into our streams. About half the population of the United States is now served with sewer systems which discharge almost 6 billion gal daily, of which half receives some treatment and the other half is discharged into the streams untreated. The rapidly increasing industrialization, with most of the plants located adjacent to, or in the vicinity of our streams, has been accompanied by the serious problem of taking care of the industrial wastes, which for the most part are discharged into the streams. This industrial waste is now equivalent to the domestic pollution of an additional 100 million persons in the United States.

As an example of a problem area, we might take the Kansas River Basin, which received national attention as a result of the billion-dollar-flood of 1951 and the sharp differences of opinion of the residents of the basin as to the best method of flood control. Let us hope that the debate will not be unduly prolonged as the Kansas River Basin can expect another flood of equal or greater severity than that of 1951. Only time will tell whether the reoccurence interval will be equal to that of the past. It may happen next year, possibly not for another 10 years, or it may be deferred for several decades. We do know, however, from the 2,500-year record of stages on the Nile and the almost 1,000-year record on the Danube, that unusual and disastrous floods repeat themselves. Storage of surplus flood waters of the Kansas River for the protection of downstream areas, this storage to be released for a multiplicity of uses during the low-water season, is necessary in order to utilize the limited water resources of the basin most effectively.

Seventy-nine cities in the Kansas basin have sewer systems which serve 385,000 persons. Additional organic wastes from industrial sources contribute a population equivalent in excess of 825,000 persons, or a sewered population of 1,210,000 people. The program for improving sanitary conditions in the Kansas basin has speeded up the building of sewage treatment plants in all parts of the state. Since 1947, new treatment plants have been completed by 110 of the 270 Kansas cities which have sewer systems. Most of the remaining cities provide some kind of treatment for their sewage, which in most cases is considered adequate by the

State Board of Health. Throughout most of Kansas the record speaks for itself, indicating the desire of the state's citizens to clean up their streams.

Multipurpose reservoirs play an important role in water conservation. It is of interest to note that on Nov. 12, 1953, 75 percent of the flow of the Missouri at Omaha, Nebr., and at Kansas City, Mo., consisted of storage released from Fort Peck Reservoir. The gage height was only 0.2 ft above the absolute minimum required for water supply and sanitation. Moreover, New Orleans, La., might have been in difficulty with its water supply through salt-water intrusion if storage released from Fort Peck Reservoir, almost 2,000 miles away, had not been available. Almost 20 percent of the flow of the Mississippi River at New Orleans consisted of storage released from this reservoir. Similar benefits to cities along the Kansas River were derived from the release of storage from the Kanopolis and Harlan County Reservoirs. The Fall River Reservoir contributed similar benefits.

Conflicting demands

The first and highest use of water according to law is for human consumption, and next for domestic animals. Following this well recognized priority of use for sustaining human and animal life, conflicts frequently arise over preferential uses of water. Demands for up-valley irrigation may conflict with downstream needs for navigation, or power development, or with requirements for mining and industry. Lovers of wildlife want ample water habitat for nesting birds, while agriculturists want to drain lands for pasturage and cropping. Many of our citizens feel that the recreational use of water should have more attention.

Increasing demands for water will in many cases dictate changes in use. An outstanding example is the Rocky River Pumped Storage Plant near Milford, Conn., completed in 1928 by the Connecticut Light and Power Company. The project involves a 137,000 acre-ft reservoir into which water is pumped 230 ft from the Housantonic River. As originally planned, the water was pumped with off-peak power and used for peak loads and emergencies, thus adding a firm capacity to the company system of 40,000 kw. The reservoir has a shoreline of about 100 miles, which has become highly developed for both summer homes and year-round residences.

Out of deference to public sentiment, the company has developed a practice of drawing the lake down in the spring so that residents may repair docks and boat houses. The lake is then filled by June and held up until after Labor Day. This gives the company a gross revenue of 1.5 million dollars, but the summer tourist trade and the income from shore owners is of the order of 22 million dollars. The power company would have to experience a real emergency to justify pulling the water down during the summer months to take care of peak power loads, although the project was built originally for just that purpose.

In 1880 Congress authorized the construction of 41 reservoirs in Minnesota and Wisconsin to store winter and spring runoff and release the storage systematically during low water, so as to benefit navigation on the Mississippi River. Six reservoirs were constructed on the headwaters of the Mississippi under the project, four in the late 80's, one in 1895, and one in 1913. Although the navigation requirements have been met in large part by the construction of locks and dams to provide slack-water navigation between Minneapolis, Minn., and the mouth of the Missouri River, nevertheless there has been an almost constant tug-of-war between navigation requirements and (1) the summer-home and resort owners around the shores of the lakes, who want the water to be held at a constant level during the summer months; (2) the Indians, who want the lakes maintained at a low level in order to raise and harvest the annual crop of wild rice; and (3) the property owners along the banks of the streams below the reservoirs, who maintain that release of storage during the late summer months interferes with the harvest of crops on low-lying lands adjacent to the stream channels. The strong protests of the summer-home and resort owners around the shores of the lakes has greatly influenced, and to a large extent changed, the method of operation that was originally planned in 1880.

Another example of changing uses is provided by Bear River, which flows into Great Salt Lake. The local power company constructed five hydroelectric plants on this river and provided storage for them in Bear Lake. However, in dry years the value of water for irrigation is so much greater than the cost of power from steam that most of the runoff of Bear River is used for irrigation.

To meet the ever-increasing demand for water, more and more of our future water needs must be solved by recirculation, reclamation of used water, and better use of existing supplies. The movement of industry to the West and the development of ore in the Rocky Mountain region may force the Western States to consider reallocation of water rights, and the East must decide to what extent its cities and industries can be allowed to continue the wholesale pollution of its streams.

An estimated 170 million acre-ft of reservoir storage has been developed in the United States, but part of this is not available for conserving water for withdrawal. A substantial volume is dedicated to the control of floods and must be kept empty for the storage of flood flows. Further regulation of streams by storage may take care of a large part of our expanding water needs, but such regulation will not adequately solve our water problems. There are vast areas of undeveloped ground-water storage that, if scientifically managed, would possibly double the existing withdrawal from ground-water reservoirs. Corrective measures must be taken where over-drafts of our ground water exist, such as in the arid Southwest and certain other local areas throughout the United States.

Good soil conservation practice and proper forest and grass cover will increase the availability of water, particularly its distribution throughout the year. The opportunity exists to reduce evapo-transpiration losses, principally in the Southwest by the elimination of heavy water-using vegetation of no economic value, such as the salt cedar. The removal of salt from seawater by distillation or by chemical treatment shows promise. The artificial creation of rainfall has been the object of extensive research for only a short time, and sufficient scientific evidence has not yet been obtained to indicate the economic importance of induced rainfall.

Sound national policy needed

There is urgent need for a sound national policy for the development and conservation of our water resources which will provide for the active cooperation and joint participation of individuals and industry, as well as local, state, and federal governments. In the implementation of such a policy, it must be recognized that the narrowing margin between the present water supply and the amount ultimately available is going to require more knowledge, better engineering, and increased consideration of complicating factors on the part of all water users.

In the preparation of this article, information has been taken from the report of "The President's Materials Policy Commission, June 1952"; the PROCEEDINGS and TRANSACTIONS of the American Society of Civil Engineers; and the U. S. Geological Survey Circular 114, "The Water Situation in the United States, with Special Reference to Ground Water." The writer wishes to express his appreciation of the valuable data contained in these sources.

(First presented as an address during the hydraulics conference on pumps sponsored by Fairbanks-Morse & Co., in Kansas City, Kans., presided over by Francis M. Dawson, Director, ASCE.)

ENGINEERS' NOTEBOOK

Borax solutions found to inhibit rusting

FRED W. BLAISDELL, M. ASCE, Project Supervisor

Agricultural Research Service, U.S. Department of Agriculture
St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

The use of small quantities of borax in a recirculating water system has eliminated rusting, which previously required changing the water weekly or oftener to avoid excessive discoloration. At the time of this writing, the water is still clear after 18 months of use. The use of borax was suggested by a news item in CIVIL ENGINEERING for April 1952 (p. 76). In this item, Prof. John Newlin of the Rose Polytechnic Institute, Terre Haute, Ind., reported on the successful use of borax as a rust inhibitor.

A series of tests was conducted by the writer to determine the effect of various concentrations of borax on corrosion and on the kinematic viscosity of water. Results are reported here. In designing the tests, the writer is indebted to H. P. Knight, of the Pacific Coast Borax Company, for helpful information.

The corrosion tests were made using steel coupons cut from 1/8-in. by 1-in. hot rolled steel strip. The coupons were about 2 1/4 in. long and weighed between 35 and 36 grams each. (The recirculating system to which the results of the tests were to be applied is made up of hot rolled steel shapes, plates, and pipes.) The oxidation was left on the coupons and this provided some protection against rust. Most of the rusting occurred at the cut ends, in a hole drilled through the coupons, and where the identification numbers stamped on the coupons broke the oxide coating. Before being placed in the borax solutions, the coupons were washed in a household detergent to remove grease, then dried and weighed. At the end of the one-month test, all rust was loose. Only a slight discoloration remained after the rust was removed.

Seven concentrations of borax (sodium tetraborate decahydrate, $Na_2B_4O_7 \cdot 10\ H_2O$) were used: 0.0, 0.1, 0.2, 0.4, 0.6, 1.0, and 1.5 percent. Each coupon was immersed in 200 cc of solution. Two different waters were used for the solutions—distilled water and tap water. (Tap water is used to fill the reservoir of the recirculating system.)

Two conditions of exposure were tested: one set of samples was tested under essentially static conditions by placing them in fruit jars; the other set was placed in flasks, and the solutions were agitated by compressed air. (The latter condition more closely represents the recirculating apparatus.) The loss of solution from the agitated samples was made up by the addition of distilled water. All tests were made at room temperature. To summarize, 28 coupons were exposed in two different waters under two different conditions. Results are given in Fig. 1.

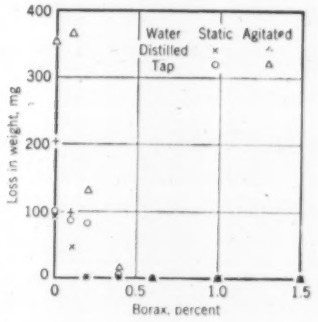


FIG. 1. Loss of weight of hot rolled steel coupons after one month in borax solutions.

It appears that 0.2 percent of borax is adequate to eliminate rust in distilled water. For Minneapolis tap water, slightly more than 0.4 percent was required. It is interesting to note that more weight was lost from the agitated solutions that rusted, but the same weight (about 2 mg, or 0.005 percent) was lost from both static and agitated solutions where the solutions had sufficient borax to protect the coupons against rust.

It appears that the addition of 0.5 percent of borax to the tap water used is adequate to prevent rust. This is borne out by both the corrosion tests and the experience with borax in the recirculating system used to test closed-conduit spillway models. In this connection Mr. Knight points out, "the optimum concentration [of borax] has been found to vary greatly with waters from various sources, and it is recommended that for use at any particular location, a rough screening be made via tests in which coupons of the metal concerned are suspended in beakers containing borax dissolved at concentrations from 0.35 percent up, in the particular water involved." He further states that "... static tests may be misleading in circumstances where circulation and/or agitation are involved, and where the water may continuously pick up more oxygen from the air."

The writer believes that no extensive series of tests is required to determine the optimum amount of borax for waters from various sources. It is necessary simply to insert coupons in various concentrations of borax and observe the rusting. Only a few days are required to determine whether the concentration is adequate. Notes taken during the writer's tests showed that the appearance of the coupons at the end of two days gave a good approximation of the final results.

Metals other than steel are frequently used in recirculating systems. Therefore the results obtained by Arthur Van Kleeck (*Proceedings*, American Wood-Preservers' Association, Vol. 38, 1942, pp. 160–172) are of interest. He used only one concentration of borax, and found that it definitely inhibited the corrosion of steel and zinc, but increased the corrosion of aluminum, brass, and copper.

The effect of borax on the specific gravity of solutions is given in Fig. 2.

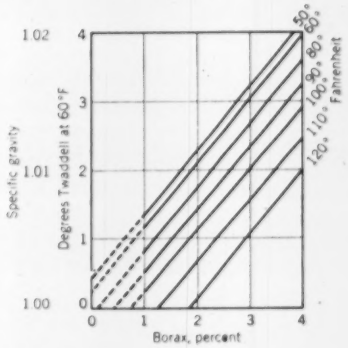


FIG. 2. Density of borax solutions. (Adapted from Pacific Coast Borax Co.)

This figure was adapted from a graph furnished by the Pacific Coast Borax Company through the courtesy of Mr. Knight. Apparently, the observations

were made in degrees Twaddell at 60 deg F. It appears from this figure that the increase in the specific gravity of water, due to the addition of amounts of borax sufficient to inhibit rust, is not sufficient to affect the results of many hydraulic research problems. For example, the addition of 1 percent of borax will increase the specific gravity by 0.6 percent at 60 deg F. This is twice the amount of borax required to prevent rust in Minneapolis tap water, yet the effect on the specific gravity is well within the limits ordinarily obtainable in hydraulic laboratory work.

Data on the effect of borax on surface tension were also furnished by Mr. Knight from a report of findings made in the laboratory of the Pacific Coast Borax Company. The results showed that borax slightly decreases the surface tension of water. The change is so small, however, as to be unimportant in most hydraulic laboratory work. For example, where without borax the surface tension at 20 deg C was 72.8 dynes per cm, 0.5 percent of borax decreased this tension to 72.3 dynes per cm, and 1.5 percent decreased it to 70.9.

No information on the effect of borax on the kinematic viscosity of water was discovered, so tests were made by the writer, with an Ostwald viscosimeter at temperatures of 60, 80, and 100 deg F. The procedure followed was that outlined in the ASME Power Test Code, Instruments and Apparatus, Part 17, Determination of the Viscosity of Liquids, 1931.

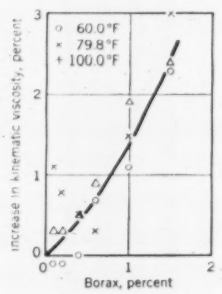


FIG. 3. Effect of borax on kinematic viscosity.

Results are plotted in Fig. 3. It is seen that the borax increased the kinematic viscosity, but its effect was only about 0.5 percent for a 0.5 percent solution. The effect on the coefficient of friction varied with the Reynolds number, but for the writer's experiment on closed-conduit spillways, the percentage effect was less than the effect on the kinematic viscosity. Here again, the effect is so small as to be unimportant in most hydraulic laboratory work.

It is concluded that borax serves as an excellent rust inhibitor for steel and zinc, and that, in the amounts required to inhibit rust, its effect on the specific gravity, surface tension, and kinematic viscosity of water can be safely neglected in ordinary hydraulic laboratory work.

New deformeter developed for structural model analysis

JOHN P. COOK, J.M. ASCE

Instructor, Rensselaer Polytechnic Institute

Troy, N.Y.

A new deformeter for the analysis of celluloid structural models has recently been developed in the Structural Engineering Laboratory of Rensselaer Polytechnic Institute. This instrument features micrometer screws for making all deformation and deflection measurements. The micrometers give accurate results and at the same time make possible a range of operation which produces deflections of convenient size on a model of practical proportions.

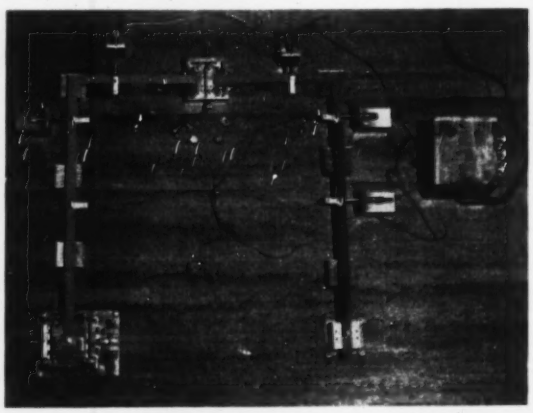
The deformeter method of analysis involves the mechanical application of the Müller-Breslau principle. The model is loaded with a unit deformation, which may be shear, thrust, or moment. The resulting deflections measured at various points of the structure represent influence-line ordinates for the stress function being considered. Two successful applications of this method of analysis are the Beggs and Eney deformeters, which have already met with widespread acceptance in the structural model field.

The new RPI equipment consists of two slightly different deformeters, one for external and one for internal use. Each is capable of loading the model with a variable range of unit deformations, which may be vertical, horizontal, or purely rotational. The accompanying illustration shows a single-span rigid frame with both deformeters mounted for use.

Deflections of the various points along the frame are measured with target micrometers. A steel needle is mounted in a light-weight target immediately above each point on the frame for which an influence line ordinate is desired. Each of these needles is wired into a series circuit with a target micrometer and a vacuum-tube contact indicator.

When the model is in the deflected position, the circuit is open. The amount of movement of the micrometer screw necessary to contact the needle and thus complete the circuit, is then a direct measurement of the deflection. The accuracy of the instant of contact is assumed by the vacuum-tube indicator.

This instrument, which was designed and built by M. W. Moakler and L. P. Hatfield, Jr., J.M. ASCE, has yielded excellent results, as compared with computed theoretical values.



New equipment at RPI Structural Engineering Laboratory consists of two deformeters—one for external and one for internal use. Here both are seen mounted on single-span rigid-frame celluloid model. External deformeter is positioned to determine left reaction components, internal deformeter to obtain shear thrust and moment of girder's mid-point. Target micrometers are mounted at five points on frame. Contact indicator is at right.

AMERICAN SOCIETY OF CIVIL ENGINEERS

HYDRAULICS DIVISION MEETING

Driskill Hotel **Austin, Tex.** **Sept. 8–10, 1954**

CO-HOSTS: AUSTIN BRANCH AND TEXAS SECTION

REGISTRATION

Mezzanine Floor

4:00–10:00 p.m., Tues., Sept. 7
8:30 a.m., Wed., Sept. 8

First Session

WEDNESDAY MORNING

SEPT. 8

Crystal Ballroom

Presiding: G. H. Hickox, Chairman, Hydraulics Division, and Walter L. Moore, President, Austin Branch

10:00 **Welcome by**

WALTER L. MOORE, President, Austin Branch

Address of Welcome
GOV. ALLAN SHIVERS of Texas

10:30 **Organization and Operation of Hydraulics Division**

G. H. HICKOX, M. ASCE, Chairman, Hydraulics Division

11:00 **Discussion from floor**

11:20 **Analysis of Hydrologic Data by the Electric Punch Card System**

IVAN M. STOUT, M. ASCE, Chief Engineer, Texas State Board of Water Engineers, Austin, Tex.

11:45 **July 1954 Unprecedented Flood on the Rio Grande**

ROBERT L. LOWRY, M. ASCE, Consulting Engineer, Austin, Tex.

HYDRAULICS DIVISION LUNCHEON

Wed., 12:15 p.m.
Mezzanine, Driskill Hotel

Presiding: W. M. Lansford, Member, Executive Committee, Hydraulics Division

Greetings from the Society:
DANIEL V. TERRELL, President ASCE
MASON G. LOCKWOOD, Vice President ASCE
WILLIAM N. CAREY, Executive Secretary

Hydraulics Down Under, by DR. VICTOR L. STREETER, Professor of Civil Engineering, Univ. of Michigan, Ann Arbor, Mich.

All sessions will be held in the Driskill Hotel

Second Session

WEDNESDAY AFTERNOON

SEPT. 8

Crystal Ballroom

Presiding: W. F. Guyton, Member, Committee on Hydrology, Hydraulics Division

Ground Water Hydraulics

2:00 **Modern Methods of Developing Ground Water Supplies**

R. M. LEGGETTE, Affiliate ASCE, Consulting Ground Water Geologist, New York, N. Y.

2:20 **Discussion from floor**

2:30 **The Irrigation Aspects of Ground Water Development**

HARRIS R. MCDONALD, A.M. ASCE, Ground Water Hydrologist, Hydrology Div., U. S. Bureau of Reclamation, Denver, Colo.

2:50 **Discussion from floor**

3:00 **Improper Well Construction Causes and Effects**

ROY A. TAYLOR, Executive Vice President, Layne-Texas Co., Dallas, Tex.

3:20 **Discussion from floor**

3:30 **Artificial Recharge of Ground Water in California**

HARVEY O. BANKS, A.M. ASCE, Assistant State Engineer; RAYMOND C. RICHTER, Associate Engineering Geologist; and JOHN W. MCPARTLAND, Assistant Hydraulic Engineer, Dept. of Public Works, State of Calif., Sacramento, Calif.

3:50 **Discussion from floor**

ICE-BREAKER PARTY

Wednesday Evening, Sept. 8

6:30 p.m. **Driskill Hotel**

For Convention attendants and their ladies.

Third Session

THURSDAY MORNING

SEPT. 9

Crystal Ballroom

Presiding: Joseph Tiffany, Member, Executive Committee, Hydraulics Division

Meteorological Phases of Flood Studies

9:00 **Hydrometeorology of the 1947 Missouri River Storm**

E. W. MCCLENDON, Hydraulic Engineer, Corps of Engineers, Omaha, Nebr.

9:20 **Discussion from floor**

9:35 **Techniques of Storm Studies**

WILLIAM NORTHROP, M. ASCE, Corps of Engineers, Kansas City, Mo.

9:55 **Discussion from floor**

10:10 **Meteorology of Major Storms**

C. S. GILMAN, Meteorologist, Hydrologic Services Div., U. S. Weather Bureau, Washington, D.C.

10:30 **Discussion from floor**

10:45 **Hydrometeorology in Design**

ROBERT W. SCHLOEMER, Meteorologist, Hydrologic Services Div., U. S. Weather Bureau, Washington, D.C.

11:05 **Discussion from floor**

11:20 **Synthesis of Rainfall Intensity-Frequency Regime**

WALTER T. WILSON, A.M. ASCE, Physicist, Hydrologic Services Div., U. S. Weather Bureau, Washington, D. C.

11:40 **Discussion from floor**

Fourth Session

THURSDAY AFTERNOON

SEPT 9

Crystal Ballroom

Presiding: T. J. Corwin, Jr., Vice Chairman, Executive Committee, Hydraulics Division

Maintenance and Operation of Flood Control Works

2:00 **Operation and Maintenance of Federal and State Flood Control Drainage and Navigation Projects**

HU B. MYERS, M. ASCE, Chief Engineer, Dept. of Public Works, State of Louisiana, Baton Rouge, La.

2:20 **Discussion from floor**

2:30 **Operation of Whitney Reservoir During the Filling of the Power Pool**

CHARLES MIRON, A.M. ASCE, Chief, Hydrology and Hydraulics Section, Ft. Worth Dist., Corps of Engineers, Ft. Worth, Tex.

2:50 **Discussion from floor**

3:00 **The Control of Floods on the Colorado River in Texas**

G. E. SCHMITT, Asst. Gen. Mgr. and Chief Engineer, Lower Colorado River Authority, Austin, Tex.

3:20 **Discussion from floor**

3:30 **Reduction of Flood Levels at the Upper Ends of Reservoirs**

BOB BUEHLER, A.M. ASCE, Hydraulic Engineer, Flood Control Branch, TVA, Knoxville, Tenn.

3:50 **Discussion from floor**

4:00 **Douglas and Cherokee Sluice Operation Experience**

GALE B. DOUGHERTY, A.M. ASCE, Hydraulic Engineer, Hydraulic Laboratory, TVA, Norris, Tenn.

4:20 **Discussion from floor**

TEXAS STYLE BARBECUE

Thursday, Sept. 9

6:15 p.m. Leave for boat or auto trip up Colorado River to Green Acres

7:30 p.m. Barbecue and entertainment

9:30 p.m. Return trip to Austin

Fifth Session

FRIDAY MORNING

SEPT. 10

Crystal Ballroom

Presiding: F. M. Bell, Member, Executive Committee, Hydraulics Division

Sedimentation

9:00 **A Reconnaissance Erosion Survey of the Cheyenne River Basin Above Angostura Dam**

H. V. PETERSON, A. M. ASCE, Staff Geologist, U. S. Geological Survey, Denver, Colo.; and R. F. HADLEY, Geologist, U. S. Geological Survey, Billings, Mont.

9:20 **Discussion from floor**

9:30 **A report on Sediment Studies of Texas Streams**

DEAN W. BLOODGOOD, Irrigation Engineer, U. S. Dept. of Agriculture, Austin, Tex.; and IVAN M. STOUT, M. ASCE, Chief Engineer, Texas Board of Water Engineers, Austin, Tex.

9:50 **Discussion from floor**

10:00 **Mechanics of Streams Flowing Over a Movable Bed of Fine Sand**

NORMAN H. BROOKS, J. M. ASCE, Civil Engineering Instructor, Calif. Inst. of Technology, Pasadena, Calif.

10:20 **Discussion from floor**

10:30 **Rates of Sedimentation in Texas Bays**

FRANCIS P. SHEPARD, Professor, Scripps Inst. of Oceanography, Univ. of California, La Jolla, Calif.

10:50 **Discussion from floor**

11:00 **Stream Flow Reactions of a Fire Damaged Watershed (in California)**

J. D. SINCLAIR, Director, San Dimas Experimental Forest Area, U. S. Forest Service, Glendora, Calif.; and E. L. HAMILTON, Forester, Calif. Forest and Range Experimental Station, U. S. Forest Service, Glendora, Calif.

11:20 **Discussion from floor**

11:30 **Visual Accumulation Tube Method for Sedimentation Size Analysis of Sands**

BYRON C. COLBY, Hydraulic Engineer, U. S. Geological Survey, St. Anthony Falls Hydraulic Lab., Minneapolis, Minn.; and RUSSELL P. CHRISTENSEN, Hydraulic Engineer, Corps of Engineers, St. Anthony Falls Hydraulic Lab., Minneapolis, Minn.

11:50 **Discussion from floor**

INSPECTION TRIP

Friday, Sept. 10

Inspection of University of Texas Campus and Engineering College and Texas State Capitol.

2:00 p.m. Leave Driskill Hotel.

5:30 p.m. Return to hotel.

Saturday, Sept. 11

The Lower Colorado River Authority which operates a chain of six reservoirs and hydroelectric plants on the Colorado River will have the facilities open for inspection. The lakes stretch over a distance of about 80 miles along the river above Austin and develop the full potential head. Of particular interest is the pumped storage installation at Buchanan Dam.

DIVISION MEMBER BREAKFASTS

Wednesday, Thursday, Friday

7:30 to 8:30 a.m.

Informal breakfasts, a la carte, in dining room reserved for those attending Hydraulics Division meeting at Driskill Hotel.

STUDENTS LUNCHEON

A student luncheon is planned to be held at the El Matamoros Restaurant, the date and time to be announced at the meeting.

LADIES PROGRAM

Wednesday, Sept. 8

9:00 a.m. Howdy Podner! Let's get acquainted over a cup of coffee in the Engineers Dining Room, Driskill Hotel.

12:15 p.m. Luncheon with husbands, Mezzanine, Driskill Hotel.

6:30 p.m. Ice-Breaker Party, Mezzanine, Driskill Hotel (husbands included).

Thursday, Sept. 9

9:00 a.m. **Tour of Austin (by bus)**

This will take about 2 hours and will include going inside the State Capitol, Governor's Mansion, University of Texas, Museum, and many other points of interest.

Evening, boat trip and barbecue

One-hour "paddle-wheel" boat trip up the Colorado River to Green Acres for a barbecue "a la Texas style" (husbands included).

Friday, Sept. 10

12:00 Luncheon, Spanish Village No. 1.

It is recommended that the women bring "cool casuals," one pair of low-heeled shoes, one "jacket dress" or sweater in order not to get too chilled in air-conditioned buildings.

COMMITTEES

Robert L. Lowry, *General Chairman*
John H. Montgomery, *Vice Chairman*

COMMITTEE	CHAIRMAN
Housing	Ben Ewing
Finance, Registration, Reception	John A. Focht
Publicity	John H. Montgomery
Student Activities	W. E. Barker
Technical Program Assistance	R. F. Dawson
Entertainment, Excursions, Women's Activities	Mr. and Mrs. Trigg Twichell
Exhibits, Demonstrations	H. C. Pritchett

EXHIBITS AND DEMONSTRATIONS

A feature of the meeting will be special exhibits of hydraulic interest. This will include a display of stream-measuring equipment by the U. S. Geological Survey, punch-card equipment for hydrologic data, and sediment samplers of various kinds.

HOUSING ACCOMMODATIONS

The Driskill Hotel will be the headquarters for the meeting, and a registration and information desk and a ladies' lounge will be maintained on the mezzanine floor throughout the meeting. A variety of accommodations are available as listed below, and delegates should make reservations directly with the reservations clerk of the hotel or tourist court of their choice as early as possible.

HOTELS

The major hotels are in the downtown area and are all within $1^1/_2$ blocks of the headquarters hotel. All rooms have bath, air conditioning, and telephone. Television is available in each case. Rates for singles are for one person and rates for double bed rooms and twin bed rooms are for two people. Larger rooms and suites are also available.

Hotel	Rates
Driskill Hotel	
Single	$4.00 to $10.00
Double	5.50 to 10.00
Twin	7.00 to 15.00
Stephen F. Austin Hotel	
Single	$4.00 to $ 6.50
Double	6.00 to 8.00
Twin	7.00 to 9.00
Commodore Perry Hotel	
Single	5.00 to 8.00
Double	8.00 to 12.00
Twin	8.00 to 12.00

Tourists Courts

There are numerous motor courts in Austin which are attractive and convenient. Two of these are described below. Both are approved by AAA, have convenient dining facilities, telephones, air conditioning, television, and private swimming pools.

Motel	Rates
Mount Vernon Motor Courts *4001 East Avenue* (48 units)	
Single	$5.00
Double	7.00
Twin	7.00
Terrace Motor Hotel *1215 South Congress Ave.* (211 units)	
Single	5.50
Double	7.00
Twin	8.50

THE READERS WRITE

Against bidding

To the Editor: In comment on the excellent articles carried in recent issues on bidding for engineering services, I believe other engineers will be interested in the record of our firm's experience in June of this year.

A real estate developer wrote to our organization requesting a "bid price per lot for the complete engineering work to be done on . . . . tract." In reply we said:

" . . . . This is the first time we ever have received such a proposal in writing. While we usually give a client an estimate of his proposed costs, including engineering, we have never bid against any other engineer for engineering services.

"A client should have the privilege of choosing an engineer best suited to his needs. This choice should be based on a number of qualifications. If price is the only basis for such a selection, the client has lost the privilege of choice and is morally obligated at least to take the cheapest price. This puts the engineer in the position of auctioning his professional services. We have never engaged in such a practice and we do not propose to start now.

"The engineer receiving a job as low bidder would be in the position of a subcontractor. The usual subcontractor, however, has a set of plans and specifications to guide him on his bid. Your letter gives no hint of whether you wish a planning design, drainage problems analyzed, or what other engineering problems should be included.

"We hold that while your engineering is a comparatively small item in your overall tract costs, it is extremely important. A good engineer makes your job go smoothly, saves you money in design and helps you through the ever-increasing problems of official regulations. These things take professional competence, imagination and interest in your job, which in our opinion cannot be secured by bidding.

" . . . . We will be glad, like any other engineer, to discuss the requirements of the subdivision and our rates and methods of charging. But thereafter it is your privilege to decide which engineer best suits your needs."

Wallace C. Penfield, A.M. ASCE

Penfield & Smith

Santa Barbara, Calif.

Coal recovery plant has many unusual features

To the Editor: The article by Paul Levin and D. I. Smith, "Six-Million-Dollar Plant Recovers Fine Coal from Susquehanna River," in the July issue, illustrates the careful thought and attention to detail which the engineers of the Pennsylvania Water and Power Company put into the planning and execution of this project. The opportunity to participate in a small way in such a job well done is one of the principal joys of the engineering profession.

Because of its low specific gravity, coal is one of the easiest minerals to float, but the use of flotation for cleaning coal has not been extensively employed in this country, probably for economic reasons. The plant described in this article is an excellent example of the results that can be obtained in cleaning coal by this method.

Conservation and clean stream programs may be a factor favoring flotation in the years ahead. In England, both before and since nationalization of the coal industry, the effort to clean up coal washery plant effluents and streams has been much more pronounced than in this country. Probably some 150 coal washeries in England, operating or now under construction, are utilizing flotation for the recovery of fines, and in addition flocculation for the clarification of plant waste waters to prevent stream pollution. Flocculation was not required for this plant to comply with Pennsylvania law. By decanting from a settling basin of large area, only a small part of the very finest particles are carried in the effluent.

As the steel framework of the washery building was completed, the flotation machines and vibrating screens were

hoisted through the framework and temporarily suspended over their final resting place. Then the concrete floors were poured and the equipment was lowered to rest on them. This was also done with the centrifuges in the centrifuge building. This method saved a great deal of time and labor in moving bulky and heavy equipment into final position.

The washery building and centrifuge building have continuous rows of windows giving good daylighting. Copper flashing was not obtainable at the time this plant was constructed, and stainless steel flashing was used, resulting in an attractive but inconspicuous contrast with the transite siding.

All feed boxes, hoppers, chutes, and launders were completely detailed and shop fabricated, and were fitted into place with a minimum of labor in the field.

Frequent and regularly scheduled meetings with the owner's representatives at the job site resolved construction and design problems as fast as they arose and resulted in a completely expedited and rapidly constructed job.

R. T. Lassiter, M. ASCE

District Manager, Western Knapp Engineering Co.

New York, N.Y.

Mirror-like globe probably used as reflecting signal

To the Editor: The mirror-like globe described by Thomas Doane Perry in the June issue (p. 71) was probably used as a reflecting signal. A spherical mirror will reflect the sun's rays from almost any angle and in almost all directions; the only completely dark condition would be when the sphere is exactly on line between the observer and the sun.

In 1925 I was mapping in western Colorado for the Topographic Division of the U.S. Geological Survey. H. H. Hodgeson, former ASCE member and now retired, was in charge of the several parties, and at the time was extending a net of triangulation to control the mapping. Difficulty in seeing some of the signals led to discussions about the practicability of using a reflecting sphere. One of the rodmen, Westhaver, I believe, was his name, fresh from a chemistry course in college, volunteered to try his hand at silvering some spherical flasks about eight or ten inches in diameter. These were raised on several mountain peaks and, as I remember, served their purpose very nicely until roving hunters used the glittering globes for target practice.

G. S. Druhot, A.M. ASCE

Topographic Engineer U.S. Geological Survey

Washington, D.C.

Secondary effects of prestressing may contribute to instability of beams

To the Editor: This is in reference to the prestressed concrete beams described by Col. Robert E. Snetzer (April issue, p. 41) and to Mr. Uno Kula's analysis of their stability (June issue, p. 71).

It seems very unlikely that the force exerted by the tensioned steel, or the concrete compressive stresses associated with this force, had any influence on the stability of the beam. Provided that the steel is in lateral contact with the beam at a sufficient number of points, the prestressing force cannot cause buckling of a concrete element regardless of how long and slender the concrete element may be. This fact has been demonstrated both theoretically and by experiment (see Magnel, *Prestressed Concrete*, Concrete Publications Limited, London). While Mr. Snetzer does not cover this point, it seems probable that the steel ducts were grouted prior to lifting the beams, and such grouting would provide lateral contact between steel and beam at all points throughout the entire length. Even if the duct was not grouted, the clear space between wires and duct is so small as to make intermittent lateral contact very likely. Consequently the kind of instability suggested by Mr. Kula seems not to have been a factor in the erection difficulty experienced.

Long slender beams are, of course, susceptible to buckling whether they be of prestressed concrete, ordinary reinforced concrete, structural steel, or timber. The hazard of buckling is apt to be greatest during erection, at which time the restraints associated with end connections and lateral bracing are not yet in effect. The beams described are unusually slender and an analysis in advance of erection probably would have indicated the desirability of special precautions. As Mr. Snetzer has pointed out, the relatively high center of gravity would be an important factor in any such analysis.

It may be worth noting that prestressing can cause certain secondary effects which may contribute to instability. For example, small lateral eccentricity of the steel in its duct might distort the lower flange, which could result in torsional moments associated with the girder weight. As another example, if the concrete compressive stresses due to the prestress force were unduly high, the effective modulus of elasticity might be appreciably less than it would be for a more moderate stress condition. Neither of these influences is likely to be of significance in any practical construction although it is important to minimize lateral eccentricity of the steel for a reason other than stability, that is, to avoid excessive lateral bending stresses in the flange.

It must be acknowledged that prestressed concrete beams frequently are of rather slender proportions, and for this reason the question of stability may merit consideration in prestressed concrete more often than in non-prestressed construction. However, when lateral contact between steel and concrete is maintained (as is the case in almost all practical prestressed concrete construction), the stability analysis is the same for prestressed concrete members as for non-prestressed members of concrete, steel or timber.

Myle J. Holley, Jr., A.M. ASCE

Assoc. Prof., Structural Engineering, M.I.T.

Cambridge, Mass.

Analyzing lateral stability of prestressed beams

To the Editor: It was most interesting to read, in the June issue (p. 71), the letters of Mr. Kula and Colonel Snetzer discussing the latter's article, "Long-span prestressed-concrete beams in Army field house," in the April issue (p. 41). As Mr. Kula says, the application of the Euler formula to the lateral stability of these long, slender, prestressed concrete beams is quite arbitrary.

It should be pointed out that the Euler formula is not applicable to problems of this type. An analysis of the lateral buckling of prestressed concrete beams would be similar to the analyses given in Chapter V of Timoshenko's *Theory of Elastic Stability*, Chapter IV of Bleich's *Buckling Strength of Metal Structures*, and numerous papers on lateral buckling in the Proceedings and Transactions of the ASCE.

Edward C. Holt, Jr., J. M. ASCE

Instructor in Civil Engineering Pennsylvania State University

State College, Pa.

Equation corrected

To the Editor: Reference is made to my article, "Preliminary Sections Determined for Concrete Gravity Dams," in the Engineers' Notebook section of the June issue. The factor b^2 was omitted from Eq. 5 (middle column, p. 69). The correct equation is as follows:

$$(1 - u)b^2 + 2.4ac + 1.4c^2 = 1 \quad \ldots \quad (5)$$

David D. Congleton, M. ASCE

U.S. Army Engineers Office of the District Engineer

Baltimore, Md.

SOCIETY NEWS

Junior Member Program to Be Featured at Annual Convention

Over 100 papers covering engineering science and practice have been developed for ASCE's Annual Convention in New York next October. Sparking Junior Member participation in the convention, a half-day session including a luncheon meeting will be held Monday, October 18, to discuss conditions of employment and professional practice. This program was arranged by the Committee on Junior Members and the Metropolitan Section's Junior Branch. Feature speaker at the luncheon will be Carl B. Jansen, M. ASCE, president of the Dravo Corp., Pittsburgh, one of the country's outstanding construction administrators. The afternoon sessions will include speakers from both construction and consulting firms. A large turnout is anticipated for this program which will be of vital concern to employers as well as to employees. Arrangements are being made for the attendance of large numbers of Junior Members, with the organization of groups being encouraged to facilitate the travel of those outside New York.

In addition to the serious side of the program, the Annual Convention Committee is working out an interesting program of social events, ceremonies, and tours. An unusual feature of the Convention will be participation in some of the events of the Columbia University bicentennial celebration. Headquarters for the Convention will be the commodious, comfortable, and centrally located Statler.

Naturally the Convention committee will make the most of the many engineering projects under construction in the New York area by arranging inspection tours. For those who are interested and can take the time, there will also be a special post-convention inspection trip by air to Bermuda to view the engineering facilities at Kinelley Air Force Base.

All Technical Divisions Will Meet

To provide outlet for the wealth of new information generated by engineers, the Technical Divisions of ASCE have scheduled a greater variety of programs, more sessions, and more panel-type presentations. Every aspect of professional practice is being covered at some point, with twelve of the Divisions presenting 35 sessions. The Soil Mechanics and Foundations Division is devoting three sessions to "Earth Dams." A three-session symposium on the subject, "Power Plant Development" will be presented by the Power Division. A special St. Lawrence Seaway Luncheon on Tuesday is to be sponsored by the Waterways Division jointly with the Hydraulics and Power Divisions.

City Planning Program

The City Planning Division has arranged a special program for Friday, October 22, which will focus attention on the vital relationship between the organization and planning for regional metropolitan areas and the inevitable impact of the peacetime application of atomic fuel.

Present plans call for a morning session to be held in Packard Auditorium on the Lehigh University campus at Bethlehem, Pa., to be followed by a luncheon with a speaker of national prominence and an

Initial excavation for ventilation tower at west end of third tube to the Lincoln Tunnel is well advanced. Construction of this new Hudson River crossing is one of the major heavy construction projects under way in the New York metropolitan area. Shield for driving under the river will be erected at bottom of shaft shown in picture and proceed toward river (to the left). About 700 ft of tunnel will pierce rock face in right of photo. Tunnel is being built by Port of New York Authority. Mason-Johnson-MacLean are the general contractors. Estimated construction cost for the project is $90,000,000.

Low Memorial Library on the campus of Columbia University, celebrating its bicentennial this year, houses the office of Grayson Kirk, fourteenth president of the university, who will be the main speaker at the Wednesday luncheon. Built in 1897, the library has been voted by architects as one of the ten most beautiful buildings in the United States. Although no longer the main repository of the university's 2,700,000-volume library, the Low Memorial Library still holds one of the country's outstanding collections on East Asia, a mathematics library, and the archives and historical items pertaining to the university's 200-year history.

afternoon session in Murphy Auditorium on the campus of Lafayette College at Easton, Pa.

The morning session will feature the presentation of papers bearing on the theory and development of nuclear energy; prospects for the use of nuclear power; the impact of atomic developments on the growth and planning of urban areas; public safety in atomic production; and prospects for local governmental structure to meet the problems of atomic development. The afternoon session will be devoted to an open-forum discussion of the subject matter of the morning program, with the morning speakers sitting as members of a discussion panel. The program is being arranged through the local program committee of the Lehigh Valley Section in conjunction with Lehigh University and Lafayette College.

Varied Social Program

The schedule of social events will offer something for every taste. There will be a "Kick-Off" party Monday evening, October 18, from 5:30 to 7:00 p.m., sponsored by the Metropolitan Section. The hotel management has agreed to set aside tables for those wishing to have dinner in the Statler's Café Rouge following the party. A name band will play for dancing during the evening.

At the Membership Luncheon on Wednesday, presentation of honorary memberships, the Society's highest honor, will be made. Grayson Kirk, president of Columbia University, will be the guest speaker. On Wednesday evening, the Metropolitan Section will be host to a reception preceding the dinner dance. Dinner will be served at 7:45 p.m. The rest of the evening (until 1 a.m.) will be devoted to dancing and to the President's reception, at which members can meet the new President. The smoker planned for Thursday evening will provide a chance to greet old friends and make new ones.

An unusual ladies' program will supplement the general social functions. One of its highlights will be an all-day inspection trip to the U.S. Military Academy at West Point. En route the ladies will have a chance to see the scenic Storm King Highway and some of the beautiful residential areas in the suburbs. It is expected that some tickets will be available for radio and television studio broadcasts. Those desiring theater tickets should write directly to the theaters as soon as possible. A listing of Broadway shows is carried in several magazines, including *The New Yorker*, and in most New York newspapers.

To Inspect Bermuda Air Base

For those who were unable to make the Bermuda trip following the 1953 Annual Convention, as well as for those who enjoyed it so much they want to go again, the Annual Convention has made arrangements with the U.S. Air Force for a repeat of the inspection trip to Kinelley Air Force Base, Bermuda. Leaving New York by air Constellation on Saturday October 23, the Bermuda tour will combine a brief holiday with inspection of engineering facilities. As an extra, the Hurricane Hunter Squadron and the Air Rescue Squadron, which are both at Kinelley Field, will give demonstrations. The commanding officer at the base will be host for this visit. Many will want to make the most of the holiday facilities at Bermuda while making the trip. With this in mind, the famous Hotel Princess has been selected for the tour, and plenty of time will be provided for sightseeing about the island.

The return to New York, on October 27, will also be by air, giving five full days in Bermuda. Arrangements can easily be made to remain longer. The all-inclusive price is $179.85 a person. To assure making the trip, early reservations are essential. Full information and descriptive pamphlets are available from Leon V. Arnold, 36 Washington Square West, New York, 11, N.Y. Mr. Arnold has arranged many such tours for ASCE.

Hotel Reservations Must be Made

A large block of rooms has been set aside by the Statler for Convention visitors. Reservations should be sent directly to the hotel and addressed to: Mr. Albert G. Cox, Assistant Sales Manager, Hotel Statler, Seventh Avenue and 32nd Street, New York 1, N.Y.

Program in September Issue

The full program of technical and social activities will be printed in the September issue.

Rights of Employee in Collective Bargaining Stressed in ASCE-AGC Discussion

Members of the ASCE-AGC Joint Cooperative Committee gathered in New York to discuss problems of the engineered construction industry vital to both engineers and contractors. Top item on the agenda was a discussion of collective bargaining for professional engineers. After review of past union activities among construction engineers, with particular reference to the situation prevailing on the Ohio Turnpike, the committee agreed to present to AGC for study, looking toward adoption, the ASCE policy on collective bargaining.

"Any group of professional employees, who have a community of interest and who wish to bargain collectively, should be guaranteed the right to form and administer their own bargaining unit and be permitted free choice of their representatives to negotiate with their employer.

"No professional employee, or group of employees, desiring to undertake collective bargaining with an employer, should be forced to affiliate with, or become members of, any bargaining group which includes non-professional employees, or to submit to representation by such a group or its designated agents.

"No professional employee should be forced, against his desires, to join any organization as a condition of his employment, or to sacrifice his right to individual personal relations with his employer in matters of employment conditions."

The group also agreed to include a study of the contractors' responsibilities in providing field layout. This subject is also to be brought to the attention of the ASCE Committee on Professional Practice. The need to strengthen work being done to enforce the laws as they relate to the organizing of professional engineers into unions was stressed, as was the need to clarify the classifications of subprofessional, preprofessional, and professional. All present concurred that continuing emphasis must be placed on the improvement of engineers' salaries and employment conditions.

On the subject of employment of young engineers by contractors, both AGC and ASCE members agreed to publicize the opportunity for civil engineers in construction and the services that the Engineering Societies Personnel Service can perform in providing engineers for the construction industry.

In reviewing developments in engineering education, it was recommended that a study be made to determine the extent to which the employer's viewpoint and needs are being considered in arranging engineering curricula. Cognizance was also taken of the shortage of adequately prepared teachers in the fundamental sciences and mathematics. The committee also concurred on the subject of promotion of con-

tacts between AGC Chapters, ASCE Local Sections, and ASCE Student Chapters in order to encourage greater contact between contractors and members of the Student Chapters.

The need for wider circulation of the ASCE periodic salary survey report was emphasized in discussing increased salaries for public works engineers. Where salaries are inequitable, great effort should be made toward adoption of new scales.

Those present at the Joint Cooperative Committee meeting representing AGC were: D. W. Winkelman, co-chairman, presiding; H. G. Dixon, A. S. Horner, and A. N. Carter, co-secretary. Representing ASCE were C. B. Molineaux, co-chairman; M. N. Quade; D. P. Reynolds, co-secretary; and R. K. Lockwood.

Pictured at New York meeting of ASCE-AGC Joint Cooperative Committee are (seated from left to right) Maurice N. Quade representing ASCE; H. G. Dixon, AGC; A. S. Horner, AGC; Charles B. Molineaux, ASCE; and Dwight W. Winkelman, AGC. Standing (in same order) are A. N. Carter, AGC; and D. P. Reynolds, ASCE.

Tellers Canvass Ballot for 1955 ASCE Officers

To the Secretary

American Society of Civil Engineers:

The Tellers appointed to count the Ballot for Official Nominees report as follows:

For Vice-President—Zone II

(Term October 1954–October 1956)

Frank L. Weaver	566
James A. Higgs	79
Scattering	321
*Ineligible Candidate	59
Void	9
Blank	47
Total	1,081

For Vice-President—Zone III

(Term October 1954–October 1956)

Louis R. Howson	764
William D. Dickinson	501
Scattering	316
*Ineligible Candidate	52
Void	10
Blank	15
Total	1,658

For Director—District 1

(Term October 1954–October 1957)

Jewell M. Garrelts	196
Stanley M. Dore	27
Scattering	175
*Ineligible Candidate	94
Void	4
Blank	15
Total	511

For Director—District 2

(Term October 1954–October 1957)

Frederick H. Paulson	168
Carroll A. Farwell	16
Scattering	56
*Ineligible Candidate	57
Void	0
Blank	4
Total	301

For Director—District 6

(Term October 1954–October 1957)

George S. Richardson	222
Scattering	35
*Ineligible Candidate	20
Void	0
Blank	6
Total	283

For Director—District 9

(Term October 1954–October 1957)

Don M. Corbett	249
Craig P. Hazelet	23
Scattering	27
*Ineligible Candidate	29
Void	0
Blank	14
Total	342

For Director—District 10

(Term October 1954–October 1957)

Graham P. Willoughby	298
Ernest M. Titus	270
Scattering	40
*Ineligible Candidate	18
Void	0
Blank	3
Total	629

For Director—District 11

(Term October 1954–October 1957)

Lawrence A. Elsener	395
Scattering	190
*Ineligible Candidate	147
Void	1
Blank	4
Total	737

Total number of ballots counted 5,542

Ballot envelopes without signature 13

Respectfully submitted,

FRANK C. MERGAIN
Chairman
JOEL E. FISHER, JR.
Vice-Chairman

Victor Feigelman	William J. McGraw
Arthur R. Luecker	Gerard F. Fox
Leroy V. Porter	Samuel L. Gatslick
Edward N. Whitney	Herbert M. Mandel

(*Tellers*)

* These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI, of the Constitution.

ASCE Honorary Member J. M. R. Fairbairn Dies

John M. R. Fairbairn, distinguished Canadian railroad engineer and Honorary Member of the Society, died in Montreal, Canada, on May 27 at the age of 80. Mr. Fairbairn entered the service of the Canadian Pacific in 1892, following his graduation from the University of Toronto. He advanced from assistant engineer to chief engineer—a post he held for twenty years prior to his retirement in 1939. During Mr. Fairbairn's tenure as chief engineer he played a prominent part in the design and construction of terminals in Quebec, Montreal, and Winnipeg, and of such company hotels as the Chateau Frontenac, the Royal York, and the Banff Springs. In 1941 he came out of retirement to aid the war effort in the Department of National Defense.

Active in professional circles, Mr. Fairbairn was president of the Engineering Institute of Canada in 1921 and recipient in 1946 of its highest award, the Sir John Kennedy Medal, and president of the American Railway Engineering Association in 1925. Joining ASCE as a member in 1913, Mr. Fairbairn was elected to honorary membership in 1939.

J. M. R. Fairbairn (1874–1954)

Engineers Joint Council Changes Constitution

A final draft of proposed changes in the constitution of Engineers Joint Council was submitted to each of the eight constituent EJC societies on April 29, 1954. The proposed amendments would provide for four classes of membership: Constituent Society, Associate Society, Affiliate Society, and individual member. EJC reports action taken by the constituent societies on these changes to be as follows: Four, including ASCE, approved all the changes without exception; all but AIEE approved all changes except the provision for individual members; AIME and SNAME disapproved the provision for individual membership; and AIEE and ASEE tabled action on it.

At a meeting of the Executive Committee of the Council on July 8, President Thorndike Saville declared that the new constitution has been approved with the exception of Article V, which provides for individual membership. Referred to the Committee on Constitution and By-Laws was the problem of drafting by-laws to implement the adopted constitutional provision for the admission of Associate and Affiliate Societies.

No change is proposed in Article I, which states the name and objectives of EJC.

Changed Article II redefines a Constituent Society of EJC as one having a membership of at least 5,000 individuals, and a voting membership confined to individuals, a majority of whom must be graduates of recognized engineering colleges or be licensed to practice professional engineering.

A new Article III provides for membership in EJC as dues-paying, non-voting Associates, those national engineering societies having a membership of less than 5,000. A majority of the members of an Associate Society must be graduate engineers or be licensed to practice as professional engineers.

The new Article IV provides for membership in EJC as dues-paying, non-voting Affiliates those regional engineering societies which are composed of voting members whose professional qualifications are equivalent to those required of the members of the constituent EJC societies. There will also be admitted as dues-paying Affiliates without vote those federations of engineering societies, or sections of them, in which a majority of the voting members are engineering graduates or hold licenses to practice engineering.

The proposed new Article V of the constitution, which was not approved, would admit individual members on a voluntary, non-voting, dues-paying basis. To qualify, applicants would be required either to hold voting membership in a Constituent Society or Associate of EJC, to have an engineering degree from a recognized college of engineering or to have equivalent attainments, including six or more years of satisfactory engineering experience.

Unfavorable action on the provision for individual membership in EJC means that after all the constituent societies have acted and reported on Article V—two tabled it—further effort will be made to rework an acceptable provision.

Congress on Large Dams to Be Held in Paris in 1955

Engineers wishing to attend the Fifth International Congress on Large Dams—sponsored by the International Commission on Large Dams of the World Power Conference and scheduled to be held in Paris next summer—are reminded that attendance at such congresses is limited to members of the national committees which make up the International Commission. American engineers who are not members of the United States Committee on Large Dams, should get in touch with either J. W. Stanley, secretary of the USCOLD, P.O. Box A-A, Boulder City, Nev., or L. N. McClellan, chairman of the Membership Committee, USCOLD, Building 53, Denver Federal Center, Denver, Colo.

The projected Fifth Congress in Paris will be followed by study tours in France and North Africa. The dates are May 31–June 17, 1955.

San Diego Engineering Council Has Active Year

Completion of a highly successful year is reported by the San Diego Engineering Council. Formed to assure unity of thinking and action among the three Founder Societies in the area, the Council is made up of two delegates and two alternates from local sections of each of the three societies—ASCE, AIEE, and ASME. In addition to meeting at least four times a year, the Council sponsors an annual joint meeting of all members of the three groups and their ladies.

Principal activities of the Council in the past year have included a counseling service for high school students considering civil engineering careers; aid to the local Office of Civilian Defense in making a Shelter Survey for the city; and aid to the San Diego Chamber of Commerce in conducting opinion polls on vital community issues.

J. Frank Jorgensen, A.M. ASCE, is retiring chairman of the Council.

Guide Issued by Committee of Design Professions

To assure proper division of responsibility among professional groups concerned with the design of a given project, *A Guide for Collaboration* has been prepared by the Executive Committee of the Joint Committee of the Design Professions, which was set up several years ago to resolve differences in opinion among such cooperative design groups. Specifically, the Executive Committee was charged with "the formulation of a general program of cooperative effort between the various elements of the design professions to provide a common meeting place to discuss and resolve problems relating to the profession as a whole, be it architectural, engineering, or their affiliated arts." The *Guide for Collaboration*, developed by the Executive Committee, may be obtained from the Office of the Joint Committee of the Design Professions, 1735 New York Avenue, N.W., Washington 6, D.C.

The Executive Committee is headed by Roy F. Larson, American Institute of Architects, as chairman. The other members are Craig P. Hazelet, ASCE; Russell H. Riley, American Society of Landscape Architects; and S. Logan Kerr, ASME.

Irrigation Conference to Meet September 9–11

With plans for the three-day meeting of the Irrigation and Drainage Division at Salt Lake City now completed, announcement is made that the conference dates have been advanced from September 16, 17 and 18 (as noted in the June issue) to September 9, 10 and 11. The program developed by the Irrigation and Drainage Division and the Intermountain Section, joint sponsors of the meeting, features four technical sessions, a luncheon, a social hour and dinner, and a field trip to examine water exchange practices in the Salt Lake Valley, and the Weber Basin, Cache Valley Drainage, and Box Elder projects. Entertainment for the ladies will be provided to wile away the hours.

Walter E. Blomgren, chairman of the Executive Committee of the Irrigation and Drainage Division, will preside over the first technical session, which will be addressed by Howard T. Critchlow, director and chief engineer of the New Jersey Department of Conservation and Economic Development; and Wells A. Hutchins and Charles M. Stokes, both with the U.S. Department of Agriculture. George N. Carter, Harvey O. Banks, and Andrew P. Rollins, are scheduled to act as chairmen for the other sessions, which will include talks on "Consolidation of Irrigation Companies and Systems," "Operation and Maintenance of Irrigation Systems," "Use and Economy of Concrete Pipe in Irrigation Systems," "Types of Ground-Water Reservoirs and Their Development," "Hydraulics of Wells," "Pumping Ground-Water as a Means of Accomplishing Both Irrigation and Drainage," "Drainage Problems and Practices Outside the United States," "Ground-Water and Drainage Problems of the Weber-Basin Project, Utah," and "Ground-Water Hydraulics of the Hoover Pilot Drain."

Although planned principally for those ASCE members whose primary interest lies in the fields of irrigation and drainage engineering, the conference is open to all interested engineers. No registration fee is required. Ample accommodations are available at local hotels and motels, in addition to those at the headquarters hotel—Hotel Newhouse, Salt Lake City. Those wishing to attend have been requested to make their own hotel reservations.

Jack W. Odell, secretary-treasurer of the Intermountain Section, 300 Federal Building, Salt Lake City 1, Utah, is in charge of advance registration and information. The conference chairman is George D. Clyde, Logan, Utah.

Cleveland Section Is Host to District 9 Council

In a talk on "Civil Engineering in the Atomic Age," which was one of the highlights of the recent two-day meeting of the District 9 Council in Cleveland, George G. Manov, acting director of the Office of Industrial Development, U.S. Atomic Energy Commission, Washington, D.C., said it would be easier to list the things that civil engineers do not do in the atomic energy program than to describe their many contributions. This country, he emphasized, "owes a debt of considerable magnitude not only to the scientists who successfully split the atom, but to the engineers who took it out of the laboratory stage." As examples of the contribution of the profession to atomic development, Mr. Manov mentioned the atomic towns of Oak Ridge and Los Alamos, which were started from scratch and required the work of civil engineers "in every step of construction."

The dinner meeting was given over to the presentation of papers by Junior Members on the topic, "How to Improve My Local Section," in the annual competition for the Daniel V. Terrell Award. David Clarke, member of the Cincinnati Section, was the winner. ASCE Vice-President G. Brooks Earnest reported on Society affairs at this session.

The Cleveland Section was host to the District 9 Council meeting, which was attended by about 80 members from Local Sections in Ohio, Indiana, and Kentucky.

Prominent at the meeting of the District 9 Council in Cleveland are (left to right) ASCE Vice-President G. Brooks Earnest; E. C. Thoma, chairman of the District 9 Council; Warren Parks, ASCE Director for District 9; David Clarke, member of the Cincinnati Section and winner of the Daniel V. Terrell Award; L. O. Harrison, Council secretary; T. P. Young, chairman of the Award Committee; and J. B. Scalzi, meeting chairman.

Junior Forum in Los Angeles Active

HAROLD A. HALLDIN, President
Junior Forum, Los Angeles Section

Junior Members throughout the Society are looking for ways and means to be more active and useful. It is the hope of the Junior Forum of the Los Angeles Section that this article may provide other Junior Members and Junior Forums with suggestions or the incentive to increase their activity in ASCE, and may make them feel they belong, are a part of the organization, not just subscribers.

Gripes and suggestions are frequently heard from members and non-members. Why doesn't ASCE do this, that, and the other thing? Well, Juniors, jot these suggestions down. Get them to your Junior Forum president. Ask him to bring the subjects up for discussion at a meeting. If they are worth while, the president will need a committee to study the subject, present recommendations, and take action. Result: One, two, three, or more Juniors become active in ASCE. Try to get the person who made the original suggestion to work on the committee along with others who show interest in his suggestion.

Since 1950 the number of Junior Members on committees of the Los Angeles Section has increased from a dozen to three dozen. Participation snowballed like this. Some one said, "It's difficult to get acquainted at the meetings." Result: Walter Babychuk, Lowell Felt, and Charles Gorham are serving on the reception committee.

"We ought to do something about salaries." Everyone volunteered. Philip Abrams, Dewain Butler, William Carroll, Buzz Gaines, Harold Halldin, William Keener, and Hugh Mulholland are currently engaged in determining: What is the economic position of the civil engineer? What has been done to improve it, and what can be done in the future to improve it?

"The Los Angeles Section Treasurer needs help." Again there was tremendous response. Tom Waters was the lucky one.

"The Los Angeles Section Secretary needs help, too." No volunteers, but Robert Chipman is busier than a bee these days helping the Secretary.

"The food is lousy in the hotel where the Section meetings are held." Phil Abrams volunteered to make a survey of other establishments. Result: ham, steak, and prime ribs of beef dinners and no automobile parking charges.

"Let's have a stag party," Bachelor Will Stokes jumped through the ring.

"What graduate courses and research programs are being offered locally and throughout the nation?" Lyle Hoag is tracking them down.

Lou Hovater and Richard Reiss recently arranged a "smoker banquet" for Junior Members only and are currently arranging a "beach party" for Junior Members and their families. "Let's have more field trips." Larry Coleman, Harry Blaney, Curtis Carlson, and Robert Davis are not sitting idle.

There are a good number of civil engineers in the construction field who should be attending our meetings. "They would if a construction group were formed." Dewain Butler and Dick Gerke are laying the groundwork. Students from Cal Tech, Southern California, Loyola and UCLA are encouraged to attend the Section meetings by John Fee, William Moffitt, William O'Daly, Robert Chipman, and Robert Prior.

"Missed the meeting last month—was there a notice of the meeting?" (A small one.) Ron Meyers is now handling "publicity."

"Why don't we have lunch together?" John Jones arranges a luncheon meeting every Friday for those who can attend.

"Aren't employment agency fees a little high in this area?" Shu Magota is studying the situation.

It has been suggested that each Junior Forum get up a newsletter for circulation to other Junior Forums. Jerry Wilson is working up one entitled "Junior Scampers." This and others may be published in "The Engineer of Southern California," with a prize offered for the best one.

"What are the Section Members doing anyway?" To find out, Dick Gerke, Tom Waters, Jack Howe, Bob Schaack, Al Osterhues, Walt Saunders, and Bob Prior are serving on the following Section committees: Senior Board, Legislation, Professional Relations and Conduct, Engineering Education, Major Disaster, Student Activities, and Membership.

The biennial Los Angeles Section *Year Book* is prepared by Junior Members Bob Davis, Curtis Carlson, Philip Benton, Bob Clawson, and Rod Lundin with a budget of $1,000. "Ladies night," arranged by Hug Mulholland, James Cheney, and James Emanuel at $15 per couple, turns out to be a $3,000 party at a famous Hollywood restaurant. Then there are the "meetings" that don't cost anything. Will Stokes arranges them.

The Los Angeles Junior Members are proud to give this brief report of their ASCE activities and to offer their thanks to Section members and their employers for the encouragement they have received.

Heading Junior Forum activities are these energetic officers (seated, left to right): Harold A. Halldin, president, and William Keener, secretary-treasurer; and (standing) William C. Gerke, past-president, and Philip Abrams, vice-president.

ASCE MEMBERSHIP AS OF JULY 9, 1954

Members	8,664
Associate Members	11,146
Junior Members	17,680
Affiliates	70
Honorary Members	41
Total	37,601
(July 9, 1953	36,384)

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Navigation aspects of the St. Lawrence Seaway Project were described at the **Buffalo Section's** June meeting by Lt. Col. James H. Holcombe, executive officer for the Buffalo District of the Corps of Engineers. Colonel Holcombe stressed the magnitude of the project, which will include canals, locks, and dams. A panel of Junior Members, with Glenn E. Sherman as moderator, put on a stimulating discussion of ways of arousing member interest in the Section at the May meeting. Others on the panel were Edward W. Umiker, Robert Patterson, Arthur G. Taylor, and Roy J. Shafer. The featured speaker was Hal Tolley, public relations director of the Cornell Aeronautical Laboratory, who outlined the role of civil engineers in the laboratory.

New **Delaware Section** officers are Earl D. Krapf, president; Joseph F. Staley, vice-president; and Vincent M. Boyce, secretary-treasurer.

For better communication among its various Branches, the **Mid-South Section** has started "on a trial basis" a readable and informative newsletter, which it calls *Mid-South News*. The round-up of news for the first issue, which was out in June, includes Branch meeting programs; highlights of the Section's spring meeting; and a miscellany of Society and Section announcements. Guest speaker at the June dinner meeting of the **Little Rock Branch** was Edward F. Rutt, chief of the Design Branch of the Little Rock District of the Corps of Engineers, who gave a progress report on design and construction of the Little Rock Air Base. At the **Jackson Branch's** June meeting Ben Collier, state aid engineer for the Mississippi State Highway Department and president of the Branch, discussed the department's state-aid program. At a recent meeting of the **Vicksburg Branch** there was a panel discussion of the Society's professional activities, with Brig. Gen. John R. Hardin, president of the Mississippi River Commission, as moderator.

Flood control and irrigation works in operation and under construction along the Republican River in Nebraska, were inspected by 55 members of the **Nebraska Section** on an all-day trip late in May. Structures on the tour included Harlan County Dam, the Frenchman-Cambridge Project, Bartley Canal and Diversion Dam, and Franklin Pumping Plant and Gravity Canal. There was a brief stop at Oxford to see the facilities and manufacturing processes at the Cen-Vi-Ro Concrete Pipe Plant. At the evening dinner meeting that followed the trip, S. R. Hubbard, chief engineer of the Cen-Vi-Ro Corp., discussed the manufacture and installation of concrete pressure pipe.

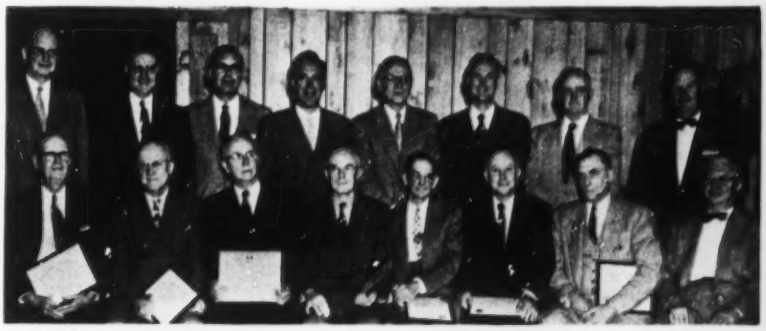
President Terrell attended the **Northwestern Section's** May meeting and presented the Section's annual Student Chapter awards. Winners at the University of Minnesota were Roger W. Young, who received first prize consisting of a handbook, entrance fee, and first-year dues in ASCE; Peter Fischer, second prize consisting of a handbook and entrance fee; and Wayne Bettin, third prize consisting of a handbook. A handbook and entrance fee went to William P. Brown, of North Dakota Agricultural College, and to John Peterson, of the University of North Dakota. A talk by Dean Terrell on the Society's plans for the future rounded out the program.

Current issues before the ASCE Board of Direction were reviewed by President Terrell at the **Oregon Section's** May meeting, which was notable for a large attendance of Oregon State College Student Chapter members.

The **Pittsburgh Section's Junior Branch** was host to the Section on May 20. Films on bridge construction were shown, and the Section conferred its annual Junior Membership awards—to Carmen M. Nicolella, of the University of Pittsburgh, and Alan E. Sleppy, of Carnegie Institute of Technology. On June 19 the Section sponsored an inspection trip to the Duquesne Light Company's Elrama Power Station, which is under construction.

Sacramento Section members were brought up to date on the city's redevelopment program at the June 1 meeting by Fred J. Grumm, chairman of the Sacramento Redevelopment Agency and retired deputy state highway engineer. Mr.

Gunnard Sigurdsson (right) of Reykjavik, Iceland, receives the Georgia Section award as highest ranking civil engineering senior at the Georgia Institute of Technology from ASCE Director James A. Higgs at a meeting on June 10. A member of the Georgia Tech Student Chapter, Mr. Sigurdsson is also the recipient of the J. Waldo Smith Hydraulic Fellowship.



Highlight of an outing and meeting, which closed Michigan Section activities for the season on June 3, was the presentation of "Distinguished Service Awards" to sixteen past-presidents of the Section. Seated, left to right, are Horace Esselstyn, Louis Ayres, Alex Trout, Robert Sherlock, William Hirn, Robert McNamee, Lewis Wilcoxen, and Milton Adams. Standing, in same order, are Dudley Newton, Edwin Finney, Clair Johnston, Clyde Palmer, Leo Garrity, George Hubbell, Ferdinand Menefee, and Thomas Hanson. Recipients unable to attend were Laurence G. Lenhardt, Perry A. Fellows, Harry A. Shuptrine, Leroy C. Smith, and Edward L. Eriksen.

Top brass at June 4 dinner meeting of the West Virginia Section shows (left to right) H. K. Griffith, state road commissioner of West Virginia; ASCE Director George W. McAlpin; Fred Palmer, president of the Section; J. C. Cobb, second vice-president of Section; C. H. Peterson, speaker of the evening; and Robert F. Baker, first vice-president. Mr. Peterson, who is project engineer for Howard, Needles, Tammen & Bergendoff on construction of the West Virginia Turnpike, showed colored construction views and discussed technical aspects of the work. On June 5 about fifty Section members made an all-day tour of the project, largely on the grade, from Charleston to the Princeton terminus. All major operations were studied.

Grumm is a charter member of the Section. Recent speakers at Subsection meetings include Theodore Neuman, of the State Division of Water Resources, who gave talks on the Feather River Project at the June meeting of the **Central Valley Subsection** at Stockton and the May meeting of the **Shasta Subsection,** and Elmer G. Ames, of the Pacific Gas & Electric Co., who described the placing of a 34-in. conduit that brings natural gas from the Texas oil fields to the San Francisco area at the May meeting of the **Marysville Subsection.**

New **San Diego Section** officers—elected at a meeting on June 22—are William J. Bobisch, president; Jean Vincenz and George R. Saunders, vice-presidents; Charles A. Smith, secretary; and Martin P. Capp, treasurer. The Encina Power Plant of the San Diego Gas & Electric Co. was discussed by Hal Noble, vice-president in charge of operation, and Walter Zitlaw, assistant superintendent in charge of electrical production.

An engineers' unity organization must provide for individual membership of civil, mechanical, electrical, and other engineers; it must be able to function for professional welfare; and it must serve the technical needs and interests of engineers. These were some of the conclusions reached by Phil Abrams in a paper on "Employer-Employee Relations," given at the May meeting of the **San Francisco Section's Junior Forum.** Mr. Abrams, who is vice-president of the Los Angeles Junior Forum, originally presented his paper at the Pacific Southwest Conference this spring. On June 19 the Section arranged an inspection trip to the new $16,000,000 San Francisco International Airport, which is expected to be in operation by September 1. Hosts to the group were the City and County of San Francisco Public Utilities Commission and the Utilities Engineers Bureau.

Seattle Section members got a look at tentative plans for the proposed 65-mile, $158,100,000 toll road from Tacoma to Everett at their June meeting, where the project was discussed in detail by Mark Forgery, district engineer, and C. K. Glaze, planning engineer for the Washington State Highway Department.

The **Syracuse Section** elected new officers at its last meeting of the season on May 12. Unanimously chosen were R. B. B. Moorman, president; C. W. O'Connell and B. M. Dawson, vice-presidents; and B. G. Barkan, secretary-treasurer. C. A. Rogus, director of engineering for the New York City Department of Sanitation, was the speaker of the evening, talking on "Sanitary Landfills."

Engineering Wonders in Texas, as seen by the **Texas Section,** are the Greater Fort Worth International Airport; the Lower Colorado River Authority Dam and Reservoir System and the Houston Ship Channel (tying for second place in the voting); the Colorado River Municipal Water District; the Orange-Port Arthur Highway Bridge over the Neches River; offshore drilling platforms and oil wells in the Gulf; the American Smelting & Refining Company's smoke stack at El Paso; and the El Paso Trainway.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N.Y.
Hotel Statler
October 18–22, 1954

SAN DIEGO CONVENTION
San Diego, Calif.
Hotel U. S. Grant
February 6–11, 1955

ST. LOUIS CONVENTION
St. Louis, Mo.
Jefferson Hotel
June 13–17, 1955

Coming Events

Hydraulics Division—Meeting in Austin, Tex., September 8–10. (Program in this issue.)

Irrigation and Drainage Division—Meeting at Salt Lake City, Hotel Newhouse, September 9–11. Other details in this issue.

Illinois—Weekly luncheon meetings featuring ten-minute speeches at the Chicago Engineers' Club, 314 South Federal St., every Friday, 12 noon.

Ithaca—Meeting of the Ithaca Section at the Cornell Surveying Camp, September 14.

Kansas—Meeting in Topeka on September 17.

Maine—Anniversary banquet at the Worster Hotel, Hallowell, Me., August 6, at 6:30 p.m., with ASCE President D. V. Terrell the guest speaker.

Mid-South—Annual meeting at the Hotel Lafayette, Little Rock, Ark., October 21–23.

Oregon—Field trip to the Dalles Dam Project on September 12.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon. Meeting of the Central Valley Subsection on the evening of September 15.

Texas—Fall meeting at the Rice Hotel, Houston, Tex., September 23–25. San Antonio Branch meets on the third Monday in August and September at Manny's Cafeteria in the Milam Building.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

More on Social Security

The proposed changes in the Social Security law (now being considered in Congress and which will have been enacted in some form before this appears in print) affect the interests of most engineers; particularly of the self-employed practitioner, but also of the many who are presently covered under Social Security and who are doing or plan to do some consulting work after the age of 65.

This new bill would apply mandatory coverage to all self-employed professional men. They would pay Social Security taxes at the rate prescribed for other self-employed persons. After the age of 65 a fully covered person would receive benefits—a maximum of over $100 a month for a single person and considerably more for a couple. He would however be permitted to earn only $1,000 a year in any gainful work. If earnings were greater, he would forfeit Social Security benefits in proportion. Under existing law one may earn $900 in "covered" types of employment and unlimited amounts in "non-covered," such as consulting work in private practice. Under the new proposal any "earned" income in excess of the permitted amount not only results in forfeiture of Social Security payments for the year, but compels the payment of a Social Security tax based on these earnings. There are some loopholes in the law as written in this bill but this is its general tenor. The bill also provides for coverage of state and local employees at the option of each particular group. The existing law would also be liberalized in several respects.

The Field Representative, both on behalf of Engineers Joint Council and of ASCE independently, has been cooperating with the other professional groups in an effort to lessen any adverse impact the proposed law might have. The medical profession as represented by AMA wants no part in Social Security. Other professional groups, including ASCE, would like to have coverage optional for the individual. Unfortunately the professional groups are in the minority, for this mandatory coverage provision has the backing of the Administration and the support of most of those groups whose members normally retire at 65, including labor and business. Regardless of the details of the particular law that is enacted, the entire question will be important as a legislative item for several years because modifications will undoubtedly have to be made. The Social Security law may be an important factor in determining your career after the age of 65.

Self-employed professional engineers are not unanimous in opposition to Social Security coverage but an unquestioned majority are opposed. Realizing that many would like to be covered and that in any event the move toward universal coverage is growing, both ASCE and EJC opposed compulsory coverage but favored voluntary coverage for self-employed engineers. The National Society of Professional Engineers took the same position.

In the House the measure was pushed through with limited debate and with a prohibition against amendments from the floor. Before the Senate Committee the professional groups received earnest consideration despite the opposition of the Department of Health, Education and Welfare, which was insistent on compulsory coverage.

The following is excerpted from the testimony presented on behalf of Engineers Joint Council by the Field Representative:

"We are in favor of liberalizing the present law—for example omitting the four lowest income years in computing average earnings and covering state and local employees, as provided in the bill. We favor a gradual extension of Social Security coverage but we feel that compulsory inclusion of self-employed professional engineers is not beneficial to these engineers and is not in the public interest.

"There is at present a critical and chronic shortage of professional engineers. Through its Engineering Manpower Commission, Engineers Joint Council has cooperated with the Government in helping to overcome that shortage. One of the obvious aids in the immediate future is for engineers over 65 to continue working rather than to retire. This bill proposes to put a premium on *not* working after age 65, and even to assess a penalty for doing so. Perhaps more than in the case of any other professional group at the present time, engineers ought to be encouraged to work beyond the age of 65 and to be exempt from mandatory coverage under this bill.

"With respect to this particular bill, self-employed engineers, who would help relieve the chronic engineer shortage if they continued in gainful work beyond 65, are now to be taxed for so doing—to pay for a supposed benefit they will probably never receive. Not only are they to be taxed at the rate they would pay as employees but at a vastly increased rate.

"Voluntary rather than compulsory coverage for professional men would, I believe, accomplish the main objectives of this bill, while avoiding most of the inequities and hardships that would result from mandatory coverage."

The ASCE Board of Direction at its June meeting voted to support the EJC position on Social Security.

[Since the above was written the Senate Finance Committee on Social Security Legislation rescinded previous action and agreed to lower the age from 75 to 72 beyond which earnings could be unlimited; to raise the limit on earnings from $1,000 to $1,200 per year as the limit which would not require sacrifice of Social Security benefits; and to change the criterion for disqualifying for benefits from "earned" income back to "earnings in covered employment," as it is under the existing law. What will happen next on the floor of the Senate or in conference is anybody's guess.]

President Boosts Highway "Grand Plan"

One of the month's headline events was the President's message to the 46th annual Governors' Conference concerning a $50 billion highway construction proposal. He emphasized the desirability of having the projects self-liquidating either through tolls or through assured increases in gas tax revenues and he suggested that the Governors advise him in the matter in time to submit proposals to the next session of Congress.

In response to the President's proposal the Governors requested the Council of State Governments, in cooperation with the American Association of State Highway Officials and other groups, to report on the status of highway programs and the position of the states with regard to highways. This report would be considered by the Executive Committee of the Governors' Conference for presentation to the President.

In view of the high priority to be given to transportation, the President has established a Cabinet Committee to help formulate a comprehensive transportation policy for the nation.

Washington, D.C.
July 19, 1954

NEWS BRIEFS . . .

ASTM Approves 65 New Standards at Annual Meeting

Many aspects of engineering materials were discussed in 110 technical papers presented at the 57th annual meeting of the American Society for Testing Materials held in Chicago, June 13–18. With 72 of the society's technical committees reporting, 65 new specifications and tests were approved and revisions in 229 existing tentatives and standards were acted on. The increased tempo in standardization activities is indicated by the fact that there are now about 2,120 ASTM Standards, compared with the 1944 figure of 1,280 and the 1934 figure of 730.

In an address entitled "Plain Talk," retiring President Leslie C. Beard, Jr., assistant director of Socony-Vacuum Laboratories, said that the sciences have become so complex and workers in them have built up their vocabularies to such an extent "that a chemist has difficulty in understanding a physicist; the biologist can't talk to the geologist; none of them can talk plainly to the engineer. Sometimes the engineer can't get his ideas across to management, and few technical people can explain their aims and what they have done to the public." The engineer can "put the scientist's discoveries on the assembly line," he concluded, "only if each has a clear idea of what the other is talking about."

The role played by sampling and quality control techniques was described, in the traditional Marburg Lecture, by Harold F. Dodge, quality results engineer for the Bell Telephone Laboratories, Inc., New York. For the annual Gillet Lecture, Francis M. Howell, chief of the Mechanical Testing Division of the Aluminum Research Laboratories, discussed the fatigue failure of metals.

Norman L. Mochel, manager of metallurgical engineering for the Westinghouse Electric Corp., Philadelphia, was elected president for the coming year. R. A. Schatzel, vice-president and director of engineering for the Rome Calbe Corp., Rome, N.Y., is the new vice-president, and C. H. Fellows, director of the Engineering Laboratory and Research Dept., of the Detroit Edison Co., Detroit, is the carryover vice-president. New directors will be E. J. Albert, Philadelphia; J. M. Campbell, Detroit; P. V. Garin, San Francisco; J. H. Jenkins, Ottawa; and D. E. Parsons, M. ASCE, chief of the Building Technology Division, National Bureau of Standards, Washington.

The 1955 annual meeting will be held at the Chalfonte-Haddon Hall Hotel in Atlantic City, June 26-July 1.

AEC Releases Complete Canned Pump Information

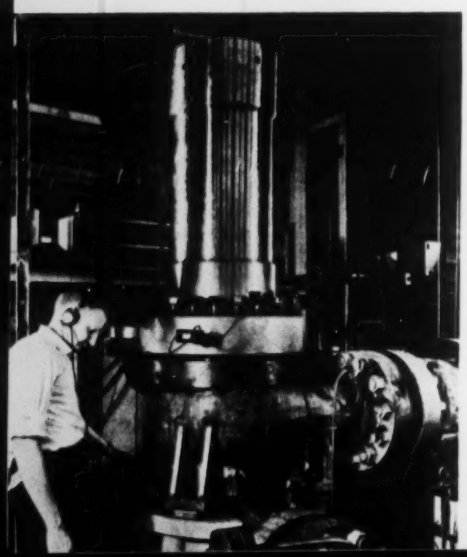
The Atomic Energy Commission has released complete design, construction, and operation data on canned electric motor-driven pumps, for the benefit of manufacturers desiring to make such pumps for either public or private use. These pumps are used in nuclear power plants to circulate primary coolant from reactor to heat exchanger, in which steam is generated for turbine operation.

In the pumps the driving motor circulating the hot water or liquid metal is actually "canned." A shrink-fit jacket of inconel metal surrounds the rotor which rotates within a stator, which is also enclosed in inconel. The fluid being pumped circulates between these "cans," and the bearings are lubricated by it.

A leak-proof hermetically sealed pump is required to prevent loss of fluid which, in passing through the reactor, may be dangerously radioactive. Three industrial firms—the Westinghouse Electric Corp., the Byron Jackson Pump Co., and the Allis-Chalmers Mfg. Co.—have been responsible for the successful development of the canned pump.

The vertical, single-stage pump (shown in the photograph), which was developed for the AEC by Westinghouse, has an efficiency of 63 percent when operating at a capacity of 4,000 gpm against a head of 125 psi, and when pumping water at 450 deg F and at a system pressure level of 2,000 psi. One such unit has operated for 50,000 hours in a test installation. Over a dozen of them have been placed in service.

Complete information, including plans and specifications, may be obtained through the Pittsburgh Area Office, AEC, Bettis Plant, P.O. Box 1105, Pittsburgh 30, Pa.



Hermetically sealed coolant pump, developed by Westinghouse for AEC, extracts heat from nuclear reactor for power plant purposes. Weight of the pump is 6,600 lb.

Marion Power Shovel Co. Acquires Osgood Co.

The Marion Power Shovel Co., manufacturer of excavating machinery since 1884, has been authorized by its directorate to accept a proposal for acquisition of a controlling interest in the Osgood Co., and its wholly owned subsidiaries, the General Excavator Co. and the Commercial Steel Castings Co.

The Osgood Co. and the General Excavator Co. manufacture lines of power shovels and cranes in sizes up to $2^1/_2$ cu yd that will supplement the Marion line. Marion machines have a size range from 1 to 45 cu yd, and the company is now building a 60-cu yd model, which will be the largest in the world. The Commercial Steel Castings Co. is a foundry operation.

Contracts Awarded for Kentucky Turnpike Project

The first three construction contracts awarded on the Kentucky Turnpike project total $6,779,589.20, a saving of $4,475,295.80 under engineers' preliminary estimates of $11,254,885, according to an announcement from the Kentucky Department of Highways. These initial contracts, which cover grading, drainage, and other preparatory work for three sections of about $12^1/_2$ miles each, have been awarded to the Breslin Construction Co. and the R. B. Tyler Co. for $1,989,206; the Codell Construction Co. and the Oman Construction Co. for $1,862,085; and Traylor Bros., Inc., for $2,928,298.10.

Actual groundbreaking for the project took place just south of Louisville during the week of July 19. Completion of the highway, which will extend from Louisville to Elizabethtown, Ky., is expected around the beginning of 1956.

Technical Staff to Pass on St. Lawrence Power Plans

Establishment of a special technical staff to implement the plans of the United States Section of the St. Lawrence River Joint Board of Engineers has been announced by the Department of the Army and the Federal Power Commission. The staff, which will be selected from existing personnel of the Army Corps of Engineers and the Federal Power Commission, will include six engineers to be stationed at Massena, N.Y., and two stationed in Washington, D.C., acting in liaison.

The staff is headed by Robert H. Hayes, former chief of engineering for the Army Corps of Engineers on construction of Garrison Dam. He has been assigned as chief engineer at Massena, center of much of the construction. The Washington unit is headed by Raymond F. Stellar as deputy chief engineer. Mr. Stellar has for a number of years been a specialist on the St. Lawrence navigation and power project.

The U.S. Section of the St. Lawrence River Joint Board of Engineers, in cooperation with a Canadian Section, will pass upon the plans, specifications, and construction schedules of the two constructing agencies for the $600,000,000 power works phase of the St. Lawrence River project. The construction agencies are the Power Authority of the State of New York and the Hydroelectric Power Commission of Ontario.

Committee Formed To Aid Railroads

Benjamin F. Fairless, M. ASCE, chairman of the board of the U.S. Steel Corp., helped to launch the activities of the Committee of Railroad Suppliers at a luncheon in New York on June 30. The committee consists of a voluntary group of suppliers who are interested in making the public aware of the vital service that railroads perform, the enormous progress they have made, and the handicaps under which they have had to operate. Despite these handicaps, Mr. Fairless said, the railroad industry has made greater fundamental advances than any other industry. No other industry, he noted, not even the steel industry, has scrapped and replaced so much obsolete equipment in recent years. No other industry has reinvested into improvements such a high percentage of its earnings. In the nine years since the end of World War II, the railroads have spent $39 billion on maintenance and $10 billion on modernization.

Grave as are the burdens of taxation and featherbedding, Mr. Fairless sees as the greatest obstacle to railroad progress the regulation under which these roads operate. Government regulation has its place; its proper function is to protect the public interest. The best way to protect the public interest, according to Mr. Fairless, is to promote competition, not prevent it.

AEC Approves New Power Reactor Study

A power reactor study will be undertaken for the U.S. Atomic Energy Commission by five Pacific Northwest utility companies, according to an announcement from AEC Chairman Lewis L. Strauss. The study, the first to be made by concerns in the Northwest, brings to thirteen the nuclear power studies being made under the Commission's Industrial Participation Program. As in the other study agreements made with the AEC, the joint group will investigate the feasibility of designing and constructing a nuclear reactor for the production of electric power.

Companies taking part in the project are the Montana Power Co., Butte, Mont.; the Washington Power Co., Spokane, Wash.; the Pacific Power & Light Co., and the Portland General Electric Co., Portland, Oreg.; and the Mountain States Power Co., Albany, Oreg.

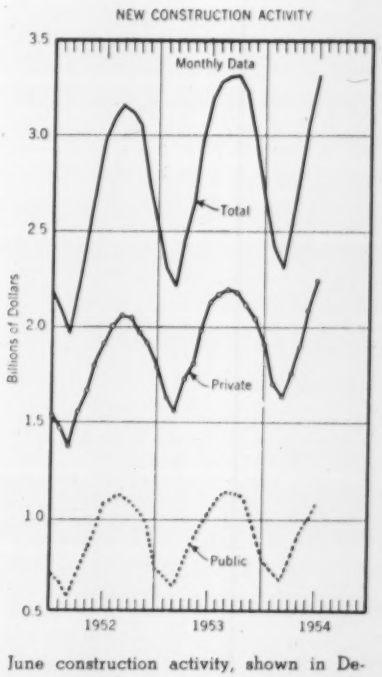
Half-Year Construction Expenditures Total Record $16.6 Billion

Expenditures for new construction rose seasonally in June to $3.3 billion, bringing the total for the first half of 1954 to a record $16.6 billion, slightly more than the 1953 January-June total, according to joint preliminary estimates of the U.S. Departments of Commerce and Labor. Private spending ($2.2 billion) and public ($1.1 billion) were both at peak for the month of June.

Most of the June increase (7 percent) in total construction reflected seasonal gains in private housing and highway construction. Commercial building and public-utility and farm construction also accounted for a substantial part of the overall rise from May. Private industrial building, after declining steadily since the beginning of the year, leveled off in June. Most other major types of construction showed the usual May-June increase, though public housing declined. Expenditures for commercial and religious building and road construction were at an unprecedented volume for the month. Spending for educational (private and public) building and for construction of sewer and water facilities was at a level unequaled in any previous month as well as at a peak for June.

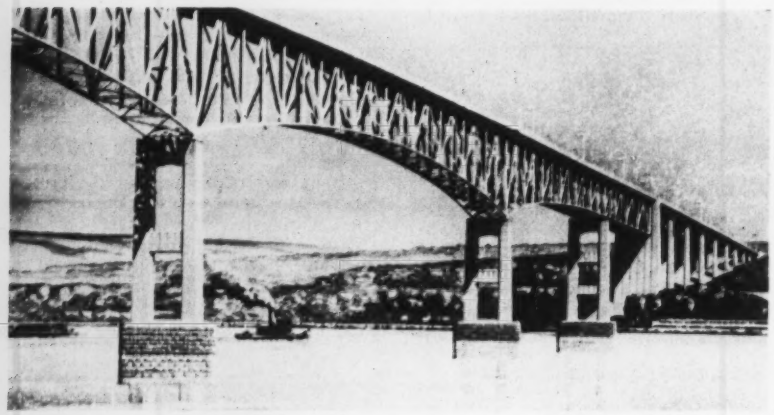
During the first half of 1954, private expenditures for new construction totaled $11.4 billion. This was about 3 percent above last year's volume for the same months, and set a new record for the January-June period, even after adjustment for price changes. Private spending so far this year has been at peak for residential building; offices, stores, and other kinds of commercial building; churches; schools; and electric light and power facilities. Private outlays have been higher for all major types of construction except industrial plant, farm, railroad, and telephone and telegraph building.

Public expenditures for new construction under way during the first half of the year totaled $5.2 billion, about the same as for the corresponding period of 1953. Declines in federal spending, especially for military facilities, were about offset by increased state and local government spending, mainly for schools, roads, and sewer and water systems, for which expenditures reached an all-time high. Federal outlays were also considerably less this year than last for aircraft and ordnance production, testing, and research facilities; conservation and development work; and hospitals. The sharpest decline in expenditures by state and local governments was for public housing.



June construction activity, shown in Department of Commerce curves, rises to all-time monthly peak, bringing half-year expenditures to record $16.6 billion.

Deck-Truss Bridge to Span Hudson Near Kingston, N.Y.



Work is about to begin on the Kingston-Rhinecliff bridge across the Hudson, following award of a $4,495,477 low-bid contract for construction of the substructure to the Merritt-Chapman & Scott Corp. The structure, designed by D. B. Steinman, M. ASCE, and shown here in artist's drawing, will be 7,793 ft long from abutment to abutment, with a 36-ft roadway flanked by 2-ft walks. New highways will link the bridge with New York State Route 9-G on the east and Route 9-W on the west. To provide the motorist with an unobstructed view of the Hudson Valley, the superstructure was designed as a deck-truss span, with all supporting steelwork below the roadway. The present contract calls for construction of the bridge's 30 twin-shaft piers of reinforced concrete (eight in the river and 22 ashore) and two abutments. The granite-faced concrete-block bases of the river piers will rest on steel H-piles driven to bedrock. Piers will range up to 195 ft in height.

Need for More and Better Trained Engineers Stressed at Annual Meeting of ASEE

The urgent need for more young Americans to enter careers in engineering and technology was stressed by Maj. Lenox R. Lohr, M. ASCE, president of the Chicago Museum of Science and Industry, in a leading talk given at the recent 62nd annual meeting of the American Society for Engineering Education, held at the University of Illinois. Speaking at the banquet on June 17, which closed the four-day program, Major Lohr said that, "Our military authorities are justly alarmed for the national security. Modern wars are conflicts of technology, demanding more and better engineers in the services and in the production of arms.

"We are rapidly losing the edge we have had on Russia," he warned. "Our superior technical knowledge has heretofore offset their greater manpower and supply of natural resources, but the gap is closing. Half the curriculum of secondary schools in Russia is devoted to scientific and technical subjects, and one third of their college students are taking engineering. Careers in engineering must be sold to young people in increasing numbers if the future welfare of the country is to be served," Major Lohr said. "Its success will depend on how well the profession can be dramatized. This task is the great new responsibility of educators in the engineering field."

Thorndike Saville

N. W. Dougherty

The theme of the well-rounded graduate who will be a leader as well as a good engineer, ran through a number of the papers and talks, which were heard by more than 1,400 engineering educators. The speakers, headed by Linton E. Grinter, M. ASCE, dean of graduate studies at the University of Florida, urged more devotion to the basic sciences and the humanities. Industrial employers, agreeing with the educators, said that they are unwilling to have colleges sacrifice the sciences and humanities to provide time for studying technology or administration. Their sales, manufacturing, and operating departments, as well as their research and development divisions, they emphasized, need engineers with strong scientific backgrounds.

The extent of the move to strengthen basic science is shown by a proposal of the ASEE's Committee on Evaluation of Engineering Education. According to the proposal, all engineering students, whatever their major, would study in common almost five-sevenths of the total course. Only two-sevenths would be concentrated in the field of the major, and almost half of this would be as electives.

Other meeting highlights included a celebration of the fiftieth anniversaries of the engineering experiment stations at the University of Illinois and Iowa State College. Donald S. Bridgman, of the American Telephone & Telegraph Co., reported that the demand from industry and government for new engineering talent continues to be greater than the current supply. Though a recent national survey indicates that the decline in business activity and defense orders in 1954 has led to a 20 percent decrease in need for engineering graduates, Mr. Bridgman said, "with the relatively small classes graduating at this time, there is still substantial unfilled demand." In another important talk, Eric A. Walker, dean of engineering at Pennsylvania State University and chairman of the Engineering College Research Council, pointed out that "The colleges of engineering of the United States must be allowed to get into atomic research if they are to support and conduct a vigorous and up-to-date educational program."

Nathan W. Dougherty, M. ASCE, dean of engineering at the University of Tennessee and former Director of ASCE, was elected president of ASEE for the coming year. New vice-presidents are Leo J. Lassalle, dean of the College of Engineering at Louisiana State University, and Harold K. Work, director of the research division in the New York University College of Engineering.

An important honor went to Thorndike Saville, M. ASCE, dean of the New York University College of Engineering, who received the organization's 27th annual Lamme Award. Dean Saville, who is president of Engineers Joint Council and a former Director of ASCE, was cited "for his distinctive leadership in organizations for advancement of the engineering profession and of engineering education." Randolph P. Hoelscher, M. ASCE, head of the engineering drawing department at the University of Illinois, was honored with the Engineering Drawing Division Award.

Record High Construction Levels Forecast for 1954

New construction expenditures are expected to reach a record high of $36 billion in 1954, 2 percent above the 1953 record level of $35.3 billion, according to revised outlook estimates prepared jointly by the U.S. Department of Commerce Building Materials and Construction Division and the U.S. Department of Labor's Bureau of Labor Statistics. The revised estimate of a 2 percent increase contrasts with a 2 percent decline expected by the Commerce and Labor Departments last November.

The present more optimistic construction outlook results largely from a higher level of new home building so far this year than was expected last November. Most other types of civilian construction also are showing greater activity than was previously anticipated and are expected to reach record or near-record levels. Current indications are that 1,080,000 new private non-farm dwelling units will be started this year, whereas earlier it was expected there would be less than a million starts during 1954. On a seasonally adjusted basis, private starts have been at an annual rate well above 1,100,000 for the first third of the year. Eased mortgage opportunities are said to be one of the mainsprings of the 1954 strength in housing.

Outlays for new commercial structures of all types are expected to go over the $2 billion mark for the first time in 1954, reflecting the recent surge in office building construction and the continued increasing emphasis on shopping centers and stores in suburban areas. The largest percentage gain over 1953 is projected for social and recreational building, which will show a 1954 increase of 32 percent.

New all-time annual highs are also in prospect in 1954 for religious building ($525 million) and for private educational building ($520 million). Utility construction generally will show only a small advance over the record 1953 activity to total $4.5 billion, with all utility types except railroad and local transit construction sharing in the gain.

Construction of new private manufacturing plants has been declining slowly since early 1954, following the rounding-out of plant-expansion goals. However, 1954 expenditures for private industrial construction are not expected to decline much below the $2 billion level, which will be around 13 percent less than in 1953.

According to the joint agencies, outlays for new public construction will also set a new record in 1954, despite a quarter-billion-dollar decline in military construction, and smaller declines in conservation and development work, public housing, and hospital building. A continued expansion in the construction of new state and locally owned projects will more than offset the reduced volume of federal spending. Highway construction, spurred by the increasing volume of toll-road activity, is expected to increase 15 percent over last year to $3.7 billion. Public school building will reach a new peak of $2 billion, an increase of 16 percent over last year, while revised levels for sewer and water facility construction indicate a record year in 1954 with $1 billion of new work.

Heavy-Particle Accelerators Authorized at Two Colleges

The U.S. Atomic Energy Commission has authorized construction of two heavy-particle accelerators—one at Yale University and the other at the University of California Radiation Laboratory—and will contribute $1,200,000 for the construction of each.

Most particle accelerators constructed to date utilize relatively light particles. The new units, however, will accelerate atomic nuclei ranging from beryllium, which has an atomic weight of 9, to neon with an atomic weight of 20. The interactions of the heavy nuclei with matter are expected to be of considerable scientific interest. The UCRL accelerator will be used primarily in nuclear chemistry studies and the machine at Yale in study of the physics of heavy-particle nuclear interactions. Both machines will be linear accelerators, and will accelerate nuclei to an energy of approximately 10 million electron volts for each particle in the nucleus—sufficient to allow the nuclei to interact with even the heaviest known elements.

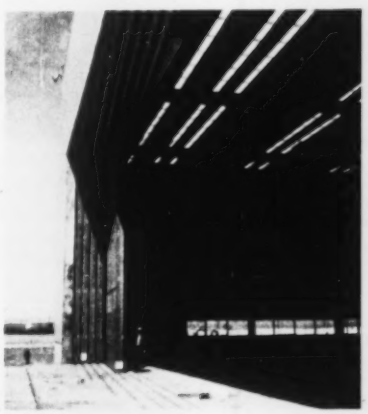
The AEC has also approved the allocation of fissionable material as fuel for a nuclear reactor to be built by the University of Michigan. The "swimming pool" type reactor will be used for the training of engineers and for research sponsored by the university and industry.

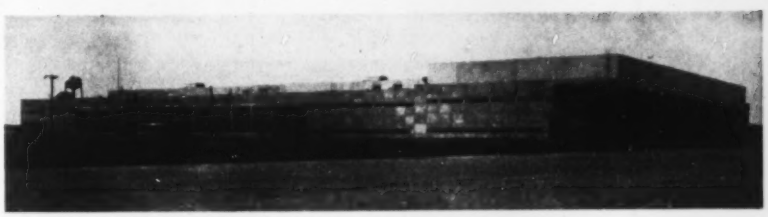
Navy Completes $20,000,000 Jet Plane Center

The U.S. Navy has just built a $20,000,000 plant for the Grumman Aircraft Engineering Corp., near Calverton, L.I., about 75 miles from New York. Located on a 4,500-acre tract, the installation is said to be the first built solely for jet plane assembly and flight operation. The layout includes hangars, warehouses, a paint shop, an assembly-administration building, a steam heating plant, a flight-operations building, and two runways—7,000 and 10,000 ft long.

Doors for the hangars are of unusual design. They consist of seven separate and independently controlled sections, each weighing six tons and measuring 20 ft wide by 36 ft high by 8 in. thick. Seven parallel floor rails permit moving one or more sections to open or closed position as desired. Each section has a push-button control that actuates a 1-hp built-in motor with gear-drive mechanism. When desired, the doors may be operated from a central control board.

The doors were fabricated by the International Steel Co. from designs by Walker & Poor, architects for the whole plant. Bethlehem Steel fabricated the structural steel, which was erected by Grove, Shepherd, Wilson & Kruge and Hendrickson Brothers. The extensive electrical system, costing $2,000,000 was installed by the Broadway Maintenance Corp.

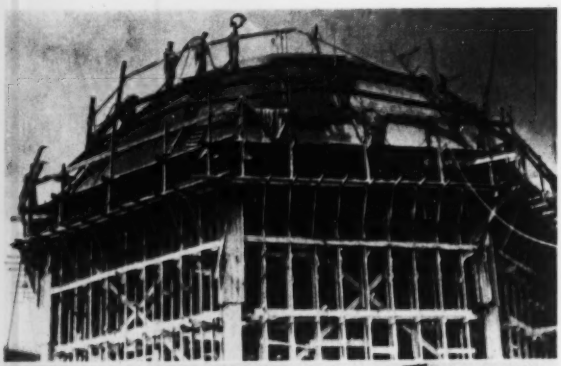




Plant of Grumman Aircraft Engineering Corp., one of world's great military flight centers, is shown in the large view. Pictured in the smaller photo is one of the seven-leaf doors that close the hangars. Each six-ton leaf is operated by a built-in 1-hp motor.

Thin Concrete Shells Studied at

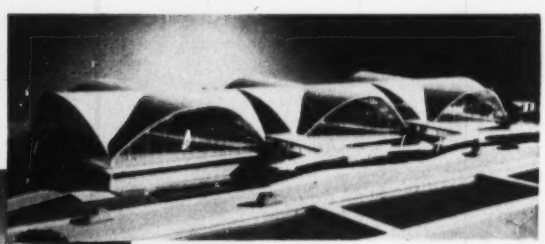
Spherical-dome $3^1/_2$-in.-thick shell roof of MIT Auditorium, Cambridge, Mass., which rests on three heavily reinforced bearings, is the work of Eero Saarinen, architect; Ammann and Whitney, structural engineers; and George A. Fuller Co., building constructors. Interior construction, designed and built to be entirely separate from shell, will provide seats for 1,200 spectators.



Planetarium dome designed and built by National Gunite Co., Inc. (John H. Hession, A.M. ASCE, president) for Museum of Science in Boston, is supported on eight columns. Gunite shell is 2 in. thick. Structure was completed in 1952. Spans of over 100 ft have been built by this method of construction.

That there is overwhelming interest in thin concrete shells was evidenced by a well-attended conference on the subject sponsored by the Massachusetts Institute of Technology, June 21–23. Imaginative designers and skilled constructors exchanged views concerning the agreements and conflicts between theoretical and actual behavior in completed shell construction. Felix Candela, head of the Mexico City firm of Cubiertas Ala, S.A., has built several daring thin-shell concrete structures $1^1/_2$ in. thick of hyperbolic-paraboloidal shape. He stated that properly designed shells develop stresses so low that ordinary concrete and semi-skilled workmen can be used to build them.

In his usual forthright way, Roger H. Corbetta, president of the New York construction firm bearing his name, said, "Let's build thin shells without the usual



Terminal buildings for Lambert-St. Louis Airport include three intersecting cylindrical shells. Architects are Hellmuth, Yamasaki, and Leinweber, and the structural engineer is W. C. E. Becker, M. ASCE. Roberts & Schaeffer Co. are consultants and designers of the roof.

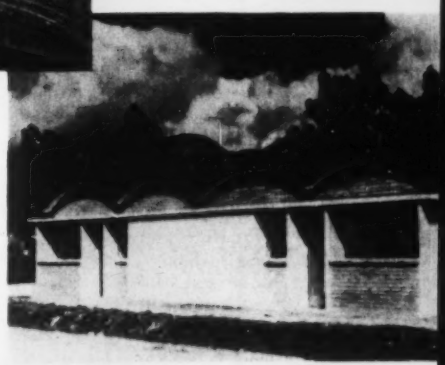
(Vol. p. 556)

MIT Conference

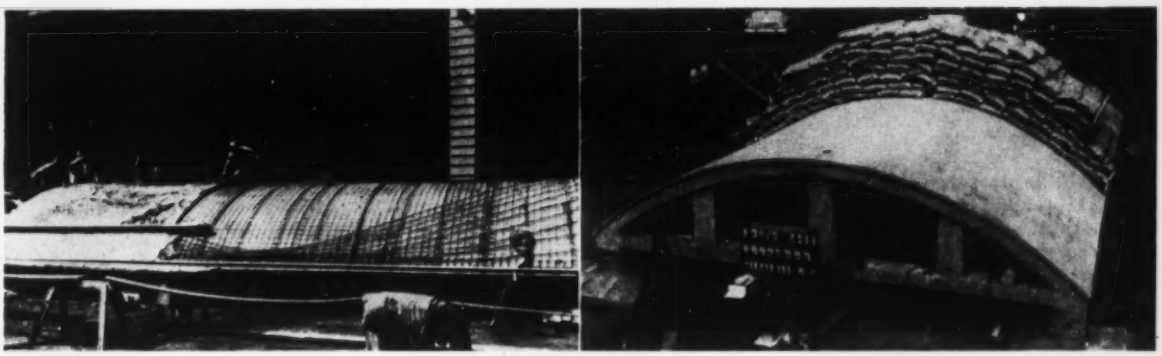
forest of forms and scaffolding. Let's use precast methods." As to the relative cost of steel and concrete structures, he stated that costs depend very much on the qualifications of the designers. A good concrete designer can design a concrete structure that will be lower in cost than a steel structure designed by a steel designer of mediocre ability, and vice versa. Too often the fee to the designer of concrete is too small to enable the economies of this type of construction to be realized. Quoting Ruskin, Mr. Corbetta said, "It's unwise to pay too much, but it's unwise to pay too little. When you pay too much you lose a little money, that is all. When you pay too little, you sometimes lose everything."

A few current examples of thin shell structures are shown on these pages.

Precast thin-shell cylindrical roof elements for 500 low-cost houses in Colombia, South America, were cast one on top of another twelve high and lifted into place with vacuum lifter. Panels which measure 16 ft 8 in. by 17 ft, $1^1/_2$ in. thick, are reinforced with wire fabric. Designed by Vacuum Concrete, Inc., Philadelphia, Karl P. Billner, president; Charles C. Zollman, A.M. ASCE, chief engineer.



Full-scale test on 31-ft by 20-ft-wide thin-shell slab with a 4-ft rise, was made by Vacuum Concrete, Inc., at University of Pennsylvania, with a 33,000-lb load at center. While deformations were appreciable, no failure occurred and, contrary to expectation, unsupported edges were displaced inward. Shell thickness varied from 2 in. at crown to $1^1/_2$ in. at springing. For one-story warehouses Mr. Billner proposes similar panels 80 ft long and 40 ft wide cast in two pieces divided along crown line, each half weighing 20 tons.



International Road Educational Foundation Set Up

Creation of an International Road Educational Foundation to enlarge its fellowship and training program for foreign highway engineers is announced by the International Road Federation. The primary purpose of the Foundation, according to R. O. Swain, executive director, is to aid in financing the advanced education in the United States of "promising young highway engineers" from foreign countries. "Such training," he stated, "will do much to advance highway development overseas."

The fellowship and training program comprises: (1) fellowships to graduate engineers for advanced study in United States universities; (2) on-the-job, paid training of foreign engineers as employees of state highway departments in the United States; (3) observation tours for study of selected state highway departments, construction projects, and municipal traffic in the United States; (4) lectures abroad by highway authorities; and (5) national training schools in countries abroad to encourage mechanization of highway departments and utilization and proper maintenance of roadbuilding equipment.

Fellowships will provide for nine months of academic study and eight weeks of practical observation of state highway departments and United States industry related to highway construction and transportation. The Federation has been awarding comparable fellowships since 1949, with recipients scattered in some forty countries around the world. Candidates are selected by national road associations in the Federation, and awards are normally made on a competitive basis. When the fellowship is completed, the recipient is required to return to his own country and continue in highway engineering. The national road associations keep in close touch with the successful graduates when they return to their homes, aiding them as much as possible.

Frank T. Magennis, chairman of the board of directors of the Federation and vice-president of the Goodyear Tire & Rubber Export Co., is president of the Foundation.

Big Shovel Digs in on West Virginia Turnpike Project

Built to move mountains is this $5^1/_2$-yd Manitowoc 4500, the largest shovel on the West Virginia Turnpike project, owned by the Latrobe (Pa.) Road Construction Co. Here the unit, which is powered by a 550-hp Model NVHS-1200 Cummins Diesel torque converter package, gets ready to load a 22-ton Euclid rear dump.

Nuclear Notes

IV—Nuclear Particles and Rays

"Nuclear Notes" are prepared for the Sanitary Engineering Division by its Committee on Sanitary Engineering Aspects of Nuclear Energy. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which includes S. T. Barker, A. E. Gorman, Prof. Warren J. Kaufman, and James G. Terrill, Jr. Next month's subject will be: "Natural Radioactivity."

How do unstable or radioactive isotopes differ from their stable counterparts? They differ in that they give off energy in the form of specific particles or rays. By this process, known as transmutation or disintegration, isotopes go from a higher to a lower energy state. This transfer of energy, which occurs at random, may take place by means of two distinct agents—either moving bodies or wave motion. Energy transfer through moving bodies by alpha or beta particles ejected from the nucleus of the atom is called particle radiation. These high-speed particles, two of the fundamental particles of nature, transfer small portions of their energy to objects in their paths, and this process continues until the energy is completely dissipated.

Some forms of nuclear radiation are not associated with particle motion, but energy is transferred through wave motion. Such radiations, that is gamma rays, are bundles of energy called photons or quanta, which originate in the nucleus of the atom and travel with the speed of light (186,000 mile/sec or 3×10^{10} cm/sec). They almost always accompany the emission of alpha particles and generally accompany the emission of beta particles.

Before describing the characteristics of alpha and beta particles and gamma rays, we must introduce and define some additional terms. One of the earliest known properties of radioactive materials was their ability to ionize air. This ability varies greatly with the energy and with the type of radiation, that is, alpha, beta, gamma, and this property may be used to identify the rays or particles. Their specific ionizations, which are defined as the number of ion pairs formed per centimeter of path length of the ionizing particles in a medium, may be compared.

Alpha particles, which are positively charged helium atoms, expend approximately 35 electron-volts for each ion pair formed, and have a short range. (An electron-volt, ev, is the amount of energy required to move one electron through a potential of one volt. One million electron volts is abbreviated as 1 Mev.) Their range in air is a few centimeters, and a single sheet of paper may be sufficient to stop these particles. As the relatively massive particle carrying two positive charges proceeds through matter, it removes electrons from their parent nucleus and leaves them strewn in the path of the alpha particles. The ionization process and other processes of energy exchange, that is, excitation, nuclear collision, etc., continue until all the energy of the alpha particle is expended, at which time it combines with two electrons and becomes a normal helium atom. Since the range of alpha particles is short, the ionization is very dense, and the trail of an alpha particle is marked by tens of thousands of ions per centimeter of path length. It is this property of producing heavy ionizations in tissue that makes alpha particles so hazardous if they are ingested or inhaled and deposited in the body. Naturally occurring alpha particles from radioactive materials have energies up to about 9 Mev.

Beta particles are positive or negative electrons moving at high velocities, and the ionizations they produce are much less dense than those of alpha particles. A beta particle carries only a single charge and has a mass approximately 1/8,000 of an alpha particle. It expends approximately 32.5 ev for each ion pair produced. Since the specific ionization of a beta particle is about 1/1,000 that of an alpha particle, the range of the beta particle is about 1,000 times greater, and is largely a function of the electron density of the media; the more electrons per path length, the shorter the distance required for absorption of beta particles.

Gamma rays (electromagnetic waves similar to X-rays but of very short wave length) ionize less effectively than either alpha or beta particles. Since they are absorbed exponentially, an infinite thickness of absorber is necessary to stop them completely. This exponential absorption is a direct result of the nature of gamma ray attenuation. Gamma rays do not lose their energy continuously in small amounts, as do alpha and beta particles, but interact with matter such that they give all (photoelectric effect or pair production) or a part (Compton effect) of their energy to an electron in a single collision. Thus the absorption of gamma rays is determined by the probability of these processes and does not change with increased path length—one such event effectively eliminates the gamma photon. Gamma rays have energies ranging from 0.1 to 10 Mev.

The practical need of knowledge of particles and rays will be apparent in later discussions of the effects of radiation on materials and in determining the amounts of shielding necessary to protect personnel and equipment from ionizing radiations.

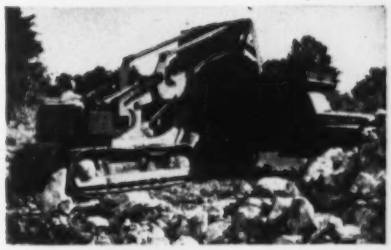
To summarize, radiations originate in the nucleus of the atom and are of two types, either particle or wave-like. Particle radiation (alpha or beta) has a range in medium which is a function of the particle energy and density of the medium through which it passes. Wave radiation (gamma) is exponentially absorbed in a medium.

[Suggested reading: Chapter 1, *Nuclear Radiation Physics*, by R. E. Lapp and H. L. Andrews. Prentice-Hall, Inc., New York, N. Y. (1948). *Source Book of Atomic Energy*, by Samuel Glasstone, D. Van Nostrand Co., Inc., New York (1950); see in particular, pp. 130-131, 149-153, 160, 165, and 168–172. *Radiological Health Training Section Notes*, Simon Kinsman, Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, Cincinnati, Ohio.]

a demonstration will show how you can . . .

cut costs, speed many jobs with this 2-yd. Tractor Shovel

The Tractor Shovel's value in mechanizing many phases of construction has been proved again and again by the versatile Allis-Chalmers 1-yd. HD-5G. The HD-9G, with its larger 2-yd. bucket, offers the same wide range of use with *double* the working capacity.



PREPARES RAW LAND with standard 2-yd. bucket, bulldozer blade or rock fork. Removes rocks, clears trees and brush, fills gullies, levels and rough grades. Angledozer blade also available. Rear-mounted scarifier increases efficiency in tough digging.

REDEVELOPS LAND — The HD-9G Tractor Shovel effectively clears and loads rubble from razed slum areas — makes land available for new building projects, parking areas, playgrounds.

EXCAVATES BASEMENTS. Efficiently digs, loads materials of all kinds. Shift pattern lets operator go from any forward to any reverse speed with one movement of shift lever . . . for faster loading cycles.

BACKFILLS, LEVELS, LANDSCAPES. Fills in plumbers' trenches, around sewer, gas and water pipe — transports excess dirt between houses, fills in around foundations, finish grades, builds driveways.

MOVES, LOADS, SPOTS MATERIALS with bucket. Also lifts, loads, skids lumber and pipe — elevates bricks, shingles to roof height. Bucket has 11 ft. 4 in. dumping height. Crane hook also available for special lifting jobs.

HD-9G — 72 drawbar hp. 29,900 lb. with standard 2-yd. hydraulic bucket.

Ask your Allis-Chalmers dealer to show how your construction jobs can be mechanized by the HD-9G, or one of the other 1- to 4-yd. Tractor Shovels — or write direct for more information.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

N. G. Neare's * COLUMN

R. ROBINSON ROWE, M. ASCE

"I liked the banquet problem," said Joe Kerr. "It was so reminiscent."

"Of winning door prizes?" prompted the professor.

"No, the gist of the problem is working out the seating at the 38 tables, which I'm good at from my college experience as usher at a hashhouse. I used a little code like:

P p-A a-S B b-S S-n N..... (1)

for the 11 people at the head table, with capitals for members, matching lower case for wives, and S for stags. That left 360 at the other 37 tables, so 27 seated 10 each and 10 seated only 9 apiece. Since the latter couldn't have more than 2 stags, each had one and looked like this:

-c C S-
H h.....(10)
-d D-e E-

where H and h are the host couple at ends of an oval table. That left 147 members and 123 wives for the other 27 tables, so the 24 stags must be paired at 12 tables like:

S-f F S-
H h.....(12)
-g G-i I-

And finally the other 15 tables without stags can be coded:

-j J-k K-
H h..... (15)
-l L-m M-

"That sets the stage for your problem, Professor Neare. Your final report stated that unrelated neighbors won in separate drawings for members and ladies and asked for the chance of such a coincidence. So I marked all eligible pairs with a hyphen and figured the number as $1\times4 + 10\times5 + 12\times5 + 15\times6 = 204$. That's another coincidence, because 25 of the 204 members, like B, C, F, N and P, haven't any chance at all!

"So I didn't care so much for the rest of the problem. Any of 204 members could win a prize, and there are 204 ways of pairing unrelated neighbors, so the chance should be 204 in 204, or a dead cinch, unless figures lie or I'm confused, or something."

"I'd say," said Cal Klater, "that Joe was a darned good usher in a hashhouse. The number of possible winning combinations is 204×167, counting that any of 167 wives might win in combination with each of 204 members. With 204 coincident pairs, the chance of one occurring is $204/204\times167$, or 1/167."

"And, of course," added the Professor, "Joe didn't have to set the tables, but just note that each wife had a chance and each hostess a second chance, adding quickly to 204. The chance is reciprocal to the number of wives only when there are as many stags as hostesses.

"Since Joe is a regular candidate for registration, he will be more interested in the chance of passing an examination if a fair number passes each problem in it. On a recent test, 176 candidates were graded 4 or better on a 6-point problem, 186 were 5 or better on an 8-point problem, and 130 were 7 or better on an 11-pointer. Grades were integers, without splitting points, and, by a triple coincidence, distribution of candidates by grades was exactly normal for each problem. How many probably passed with a total score of 16 or better out of 25 points?"

[*Cal Klaters were Stoop (John L.) Nagle, Ed C. Holt, Jr., S. K. Rueball (Keith Jones), Thatchrite (Guy C. Thatcher), and G. I. (Morton) Raff. The unrelated neighbors were Mrs. Lewis and Mr. Longwell. Also acknowledged are pentagonal-tile solutions from Holt and the Streamliner (Julian Hinds).*]

Many Cities Affected By Drought of 1953

Many public water-supply systems were affected by the widespread 1953 drought, according to a report entitled *Public Water-Supply Shortages, 1953*, which was recently made available by the U.S. Geological Survey. Announcing results of an inventory of the entire 48 states, the report reveals that 1,072, or 6 percent, of the public water-supply systems were unable to meet the peak demands of their customers. This means that about 15 of every 100 persons using public supply systems were affected. The only states reporting no shortages were Idaho, Mississippi, and Rhode Island.

The greater part of the shortages (51 percent) were found to be due to municipalities outgrowing their water-supply systems; 1 percent to increased industrial use; 34 percent to supply failure; and 14 percent to a combination of reasons. Most of the shortages were experienced by smaller towns and cities. Of the 1,072 municipalities studied, 54 percent used ground water, 39 percent surface water, and 7 percent both.

Free copies of the report, which was prepared by K.A. MacKichan, A.M. ASCE, and J.B. Graham, of the Water Utilization Section, Water Resources Division, are available from the Water Resources Review, U.S. Geological Survey, Washington 25, D.C.

All-Track Vehicles for Use in Muskeg Areas

Designed for use by the Gulf Oil Corp. in the muskeg regions of northern Canada, this special all-track vehicle will double the speed of oil exploration by making possible full-scale summer operations in boggy lands previously inaccessible except when frozen. The muskeg tractor, with its two tandem wheel tracks 29-in. wide and presenting some 5,000 sq in. of surface to the ground, can travel where a person cannot walk without sinking. Specifications stipulated that pressure per square inch of tread should not exceed $1\frac{1}{2}$ lb (a jeep exerts from 50 to 100 psi and a man from 5 to 6 psi), that the vehicle must be able to carry a 2,500-lb load in addition to its own weight of about 5,000 lb, and that dimensions must not be greater than 7 ft wide and 12 ft long for ease in transport and in negotiating timber trails. The Bombardier Co. designed and built the basic vehicle chassis, which has many interesting features. The Chrysler Industrial 116-hp motor is mounted amidships, delivering power through a four-speed synchro-mesh transmission. There is no steering wheel, steering being effected by a controlled differential transmission actuated by two levers, the one applying more power on the left-hand drive and the other on the right.

Big Rigs
Pay Off In Profits!

DON YOUNG, SUPT. GLENN OLSON, PRES.

An Actual Job Report from IH

THE G.A. OLSON CONSTRUCTION COMPANY UP IN MARSHALL, MINNESOTA, IS A LONG WAY FROM BEING A BIG OUTFIT... BUT IT DOES THINGS "IN A BIG WAY." GLENN AND BRUCE OLSON -- BOTH IN THEIR EARLY 30'S -- RUN THE SHOW...

IT'S A TIGHT SCHEDULE, BRUCE, BUT WE'VE GOT THE MEN AND EQUIPMENT TO DO THE JOB.

WE KNOW FROM PAST EXPERIENCE WHAT THOSE BIG INTERNATIONALS CAN DO. WE'LL LICK IT, GLENN!

THE OLSON BOYS STARTED EARLY... BACK IN '42, THEIR DAD, A VETERAN MINNESOTA CONTRACTOR, HAD TAKEN ON A TOUGH ASSIGNMENT WHEN HE PITTED THE G. A. OLSON CONSTRUCTION COMPANY AGAINST THE CANADIAN WILDERNESS. HIS WAS ONE OF SEVERAL AMERICAN OUTFITS PUSHING THE VITAL ALCAN DEFENSE ROAD THROUGH AHEAD OF THE SURVEYORS...

WE'D BETTER FELL A COUPLE OF LOGS ACROSS THIS BOG... THEN BRING UP THE EQUIPMENT IN THE MORNING.

RIGHT, DAD. THEN WE'LL BE SET TO TACKLE THE NEXT 10-MILE STRETCH AT DAWN.

I'LL GO BACK AND GET THE CREW TO 'LEAP-FROG' THE EQUIPMENT THROUGH THE OUTFITS WORKING BELOW.

THE CONSTRUCTION CAREERS OF THE TWO BOYS WERE INTERRUPTED BY THEIR SERVICE IN WORLD WAR II. BUT, WHEN PEACE CAME...

NOW WE CAN TEST THOSE 'BIG EQUIPMENT' IDEAS OF YOURS, GLENN.

I'VE BEEN DOING A LOT OF FIGURING, BRUCE... AND I'M CONVINCED THAT BIG RIGS WILL PAY OFF IN PROFITS. LET'S TALK TO DAD.

AND SOON...

IT'S THE BOYS' IDEA, TOM -- BIGGER, FASTER EQUIPMENT.

YOU'LL BE GLAD YOU CHOSE INTERNATIONALS. THEY STAND UP.

INDUSTRIAL POWER

THIS '24' HAS THE WORK CAPACITY THAT'LL MAKE OUR PLAN WORK, BRUCE!

THE OLSONS' FIRST I-H CRAWLER WAS FOLLOWED BY ANOTHER... AND ANOTHER. WHEN THEIR FATHER DIED IN 1948, IT SEEMED NATURAL FOR THE TWO YOUNG MEN TO CARRY ON THE FINE RECORD AND REPUTATION HE HAD BUILT SINCE HE STARTED THE COMPANY IN 1923.

HERE COME THE INTERNATIONALS

EVEN THOUGH WE ARE A MEDIUM-SIZE OUTFIT, THE BIGGEST, FASTEST EQUIPMENT WE CAN GET WILL CUT OUR UNIT DIRT-MOVING COSTS.

IT'S THE ONLY WAY WE CAN MEET COMPETITION, GLENN. WE'VE GOT TO HAVE A RUBBER-TIRED MACHINE TO HANDLE OUR LONG HAULS ...ONE THAT WILL KEEP MOVING DIRT WITHOUT DOWNTIME.

THEY HAD TO MAKE THE RIGHT CHOICE... SO THEY WENT RIGHT TO THE FACTORY BEFORE BUYING--

I LIKE THIS CLEAN DESIGN AND UNIT CONSTRUCTION, GLENN. IT'S SURE TO BE RUGGED.

IT SHOULD GIVE US VERY LITTLE DOWNTIME... AND BE EASY ON THE MAINTENANCE CREW. THAT LOOKS LIKE THE CHOICE.

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ON JOB AFTER JOB, THEIR DECISION PAID OFF. THE BIG, FAST RUBBER-TIRED RIGS WITH AN ALL-INTERNATIONAL TEAM OF CRAWLERS AND SCRAPERS--PERMITTED LOW BIDDING AND REALLY PROFITABLE PERFORMANCE... WERE USED ON MORE THAN 90% OF THE G.A. OLSON COMPANY JOBS...

AND THEN, IN 1952, CAME ONE OF THE TOUGHEST TESTS... 12 MILES OF REBUILDING ON HIGHWAY 59 IN MINNESOTA. THEY BID $173,000 FOR 386,000 CUBIC YARDS IN WET, SWAMPY LAND... AND THE BID WAS LOW. THEY HAD ONLY A 90-DAY TIME LIMIT!

RADIO FORECASTS MORE RAIN... AND PLENTY OF IT, GLENN.
WE'RE RACING THE CALENDAR NOW! OUR INTERNATIONALS HAVEN'T LET US DOWN YET, BRUCE. WE'VE GOT TO KEEP THEM MOVING...

AS RAIN FELL FASTER THAN THE EARTH COULD SWALLOW IT... 14 INCHES IN 10 DAYS... WATER LAY INCHES DEEP ON THE HIGHWAY RIGHT-OF-WAY. ALTHOUGH THE OLSON OUTFIT WAS PINNED DOWN FOR DAYS AT A STRETCH, THEIR EXPERT OPERATORS AND TEAM OF BIG INTERNATIONALS KEPT LOADS OF SOGGY, WATER-LOGGED MATERIAL MOVING ON DAYS WHERE IT LOOKED IMPOSSIBLE...

AS THE TIME LIMIT DRAWS NEARER AND NEARER, MEN AND MACHINES PUSH HARDER AND HARDER IN THEIR BATTLE AGAINST THE ELEMENTS. AND THEN--

THE WEATHER CLEARED.. AND WORK SPEEDED UP. FAST LOADING, CARRYING AND DUMPING BROUGHT THE G.A. OLSON COMPANY THROUGH AHEAD OF SCHEDULE!
WELL, YOU CAN SAY WE HAD PRACTICALLY NO MACHINE DOWNTIME. THOSE I-H UNITS CAN REALLY TAKE A BEATING!
FACT IS -- SINCE WE'VE GOTTEN ALL I-H EQUIPMENT, WE'VE CUT OUR DOWNTIME IN HALF.

YES, WE'RE MOVING MORE DIRT NOW WITH LESS EQUIPMENT... AND AT A LOWER COST PER YARD -- THANKS TO INTERNATIONAL!
WELL, THANKS, MR. OLSON. IT'S A GREAT STORY... AND WE'LL TELL IT JUST AS IT HAPPENED.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

INTERNATIONAL HARVESTER

INTERNATIONAL

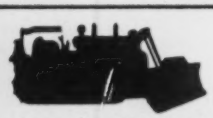
MAKES EVERY LOAD A PAYLOAD

Now All in One Family

the hardest-working work teams in the world!

TD-24 crawler with matched scrapers

TD-18A crawler with matched scrapers



TD-24 crawler with bullgrader

TD-9 crawler with hydraulic bulldozer

TD-6 crawler with hydraulic bulldozer

TD-14A crawler with cable bullgrader

TD-9 tractor with front-end loader

TD-18A crawler with sideboom

Model 2T-75 two-wheel, rubber-tired tractor with 18-yard heaped capacity scraper

Model 2T-75 two-wheel, rubber-tired tractor with 20-yard heaped capacity bottom dump wagon

Model 2T-55 two-wheel, rubber-tired tractor with 13-yard heaped capacity scraper

CR-611-D. 6-20. LITHOGRAPHED IN UNITED STATES OF AMERICA

DECEASED

Gilbert Algernon Bell (A.M. '26), age 66, for the past 30 years engaged in private practice as a civil engineer in the Washington, D.C., and Maryland area, died in Washington, on June 7. A 1911 graduate of Carnegie Institute of Technology, Mr. Bell was principal assistant to E.K. Morse, of Pittsburgh, for seven years, before establishing his practice there in 1918.

Matthew B. Black (M. '51), age 70, since 1918 senior bridge designer for the Pennsylvania Department of Highways, Harrisburg, died at his home at Annville, Pa., on May 26. For the past fifteen years Mr. Black was also an engineer for the New York-Pennsylvania Interstate Bridge Commission. He was a graduate of the Massachusetts Institute of Technology, class of 1911.

Clarence Blakeslee (M. '95), age 91, chairman of the board of C. W. Blakeslee & Sons Co., Inc., heavy construction firm of New Haven, Conn., died there on June 26. Mr. Blakeslee had been associated with the firm, founded by his father, since 1894. At various periods he was also president of the New Haven Gas Co. and the New Haven Water Co. Early in his career he was employed as a division engineer by the New York, New Haven and Hartford Railroad. He graduated from the Sheffield Scientific School at Yale in 1885 and was a member of the Yale Corporation.

James Churchill Boyd (M. '07), age 82, retired consultant of Portland, Me., died on January 18 at Fort Lauderdale, Fla., where he was spending the winter. A graduate of the Massachusetts Institute of Technology, Mr. Boyd was with Westinghouse, Church, Kerr & Co., New York engineering and construction firm, from 1902 until his retirement in 1920. He was successively construction engineer, chief engineer, vice-president, first vice-president, and acting president. Subsequent to his retirement, he moved to his old home in Portland, where he had a consulting practice, except for a two-year period as treasurer and director of F. H. McGraw Co., New York.

Harold Jenkins Dudley (M. '45), age 52, construction engineer and general contractor of Baltimore, Md. died there on April 30. Mr. Dudley had headed his own business since 1939. At various periods Mr. Dudley was employed by the Tifft Construction Co. and the Semet Solvay Co., Buffalo, N. Y.; the Koppers Construction Co., Pittsburgh; A. Bentley and Sons Co., Toledo; H. K. Ferguson Co., Cleveland; and M. A. Long and C. W. Schmidt, Baltimore. Mr. Dudley was an alumnus of Cornell University.

Kingston Allen Farrell (M. '31), age 67, consulting engineer of Ann Arbor, Mich., died on May 6. Before establishing his practice in 1948, Mr. Farrell had been a member of the Ann Arbor consulting firm of Jensen, Bowen & Farrell for more than twenty years. He was a graduate of the University of Toronto and a veteran of World War I, in which he served with the Canadian Engineers in France.

Leslie Holmes Garlinghouse (A.M. '20), age 66, co-founder and partner of Gar-Bro Manufacturing Co., Los Angeles, Calif., died in Pasadena, on June 26. Mr. Garlinghouse had been associated for 28 years with his brother, Albert F. Garlinghouse, in the firms of Garlinghouse Brothers and Gar-Bro Manufacturing Co., distributors and manufacturers of construction equipment. He retired from active participation in the companies several years ago. Earlier he was a designing engineer for Blaw-Knox Co. and the American Bridge Co., Pittsburgh, Pa. He was an alumnus of Rensselaer Polytechnic Institute.

L. H. Garlinghouse

Donald Young Geddes (A.M. '11), age 68, former assistant to the general manager of the Pennsylvania Railroad in New York City, died in St. Petersburg, Fla., on May 4. A specialist in railroad engineering, Mr. Geddes was with the Ohio River & Western Railway, and the Peoria and South Bend Division of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad before joining the Pennsylvania system in 1928. From 1928 to 1942 he was superintendent of the New York Division, and from 1942 until his retirement in 1946, assistant to the general manager of the New York Zone. He was an alumnus of Ohio State University.

George Williams Gosline (A.M. '36), since 1935 district and zone engineer for the U.S. Department of Agriculture in the Northern California and Portland, Oreg. area, with headquarters in Portland, died on May 9. Mr. Gosline had previously been in the employ of the Jones & Laughlin Steel Corp., the California Division of Water Resources, and the city of Santa Paula. He attended the University of Nevada.

Henry Francis Hill (M. '07), age 90, retired civil engineer of Augusta, Me., died in that city on May 11. Entering private practice in 1907, Mr. Hill concurrently served as Augusta city engineer from 1909 to 1930. In his early years he was in the engineering departments of railroads in Colorado, New Mexico, Missouri and Maine. He was educated at Massachusetts Institute of Technology.

William Otis Hotchkiss (M. '37), age 75, since 1943 president emeritus of Rensselaer Polytechnic Institute, died at Morristown, N.J., on June 20. Before going to RPI in 1935, Dr. Hotchkiss was president of the Michigan College of Mining and Technology for ten years. He was an instructor in petrography and mineralogy at the University of Wisconsin from 1904 to 1907, and state geologist of Wisconsin 1909 to 1925. From 1911 to 1925 he was also a member of the Wisconsin Highway Commission, which he served as chairman for two years. He was an alumnus of the University of Wisconsin.

Theodore Philip Kilian (M. '41), age 69, associated with Smillie & Griffin, of New York, since 1941, died at his home in Scarsdale, N.Y., on May 14. A specialist in tunnel design, Mr. Kilian was with the New York and New Jersey Bridge and Tunnel Commission as assistant engineer and assistant design engineer (1921–1930); the Port of New York Authority as assistant engineer and designer (1930–1936); and with the New York City Tunnel Authority as design engineer (1936–1950). He participated in the design of the Holland, Lincoln, Midtown, and Brooklyn-Battery tunnels. He was an alumnus of Columbia University.

Frank L. Nicholson
Former Director, Dies

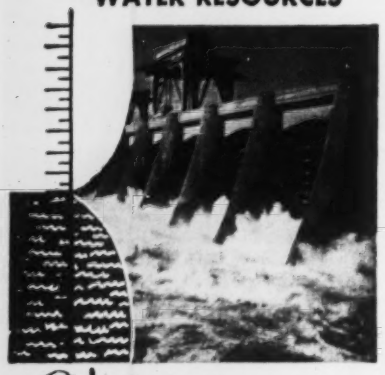
Frank Lee Nicholson (M. '05), age 85, former chief engineer of the Norfolk & Southern Railway, died at his home in Norfolk, Va., on May 24. Mr. Nicholson was connected with the Norfolk & Southern for 58 years, serving as chief engineer from 1918 until his retirement in 1947. Though retired, he continued his service with the Norfolk City Planning Commission, from which he resigned in January after seven years as chairman and 17 as a member. Active in Society affairs, he was Director from 1929 to 1931 and vice-president and president of the Virginia Section.

Frank L. Nicholson

(Continued on page 94)

BASIC DATA

FOR UTILIZING WATER RESOURCES



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Deceased

(*Continued from page 93*)

Harry Robert Knight (M. '48), age 70, designing sanitary engineer with Myron Sturgeon Engineers, Norfolk, Va., died in May 1953. Before joining the firm in 1947, Mr. Knight was an engineer on design and supervision of water and sewer systems for the towns of Wiley, Wilson and Lynchburg, Va., and town engineer and manager for Marion, Va. Earlier (1924 to 1933) he was in private practice at Palatka, Fla. Mr. Knight attended the University of Florida.

Norman Banks Livermore (M. '20), age 81, president of Norman B. Livermore & Co., San Francisco, Calif., died on December 27, 1953. After graduation from Cornell University in 1895, Mr. Livermore worked briefly for the U.S. Engineer Office, the San Diego Water Co., and the San Francisco city engineer. He entered private practice in 1902, specializing in hydraulic work, and in 1903 established the firm that he still headed at the time of his death.

Walter Timothy Nixon (A.M. '53), age 35, since 1950 structural engineer with the McDowell Co., Cleveland, Ohio, died on April 11. While residing in Akron from 1938 to 1944 Mr. Nixon was employed by the City of Akron, the Goodyear Aircraft Corp., and the Firestone Tire and Rubber Co. In 1945 he went to Cleveland as a structural engineer for the Austin Co. He was a graduate of the University of Akron.

Marcus Bogislaf Tark (M. '27), age 77, for the past ten years associate engineer of design in the Philadelphia (Pa.) Bureau of Engineering, died at his home in that city on April 28. Mr. Tark was a designer for the Link Belt Co., in Philadelphia, for 28 years before entering municipal service. He was the inventor of several sanitary engineering devices, including a sludge collector and sewage screen.

Henry Chandlee Turner (A.M. '06), age 82, founder and former president of the Turner Construction Co., New York, N.Y., died at Newton Square, Pa., on June 5. A pioneer in the use of reinforced concrete for industrial building, Mr. Turner headed the company from its organization in 1902 until 1941. He retired in 1946 after serving for five years as chairman of the board. A graduate of Swarthmore College in 1893, Mr. Turner was a member of the board of managers of his alma mater for 32 years; organizer and first president of the Metropolitan Builders Association of New York; and a past-president of the American Concrete Institute.

Henry C. Turner

(*Continued on page 98*)

Here are important facts for the "man behind the gun"

This White 18" Dumpy level has

... more of the features you want, yet costs you less!

Before you buy, compare this White Dumpy level with a similar model of any other recognized make. From every standpoint — design detail ... quality construction ... work-speeding, life-lengthening features and cost — you'll quickly see why a White's the best buy you can make. It will make your work faster, easier, more accurate. Check this comparison chart:

FEATURES	D. White No. 7080	Instrument A	Instrument B
Magnifying power of telescope	35X	30X	27X
Distance away you can read 1/100 ft. graduation	1200 ft.	1050 ft.	900 ft.
Diameter of objective lens	1.81 in.	1.485 in.	1.69 in.
Field of view (in minutes of arc)	64'	52'	60'
Coated optics	YES	YES	YES
Covered leveling screws	YES	YES	YES
Can you easily replace worn leveling screws in the field?	YES	NO	YES
Sensitivity of level vial (in seconds of arc per 2mm of graduation)	20"	20"	25"
Price — complete with carrying case, tripod and accessories — F.O.B. factory	$295.00*	higher	higher

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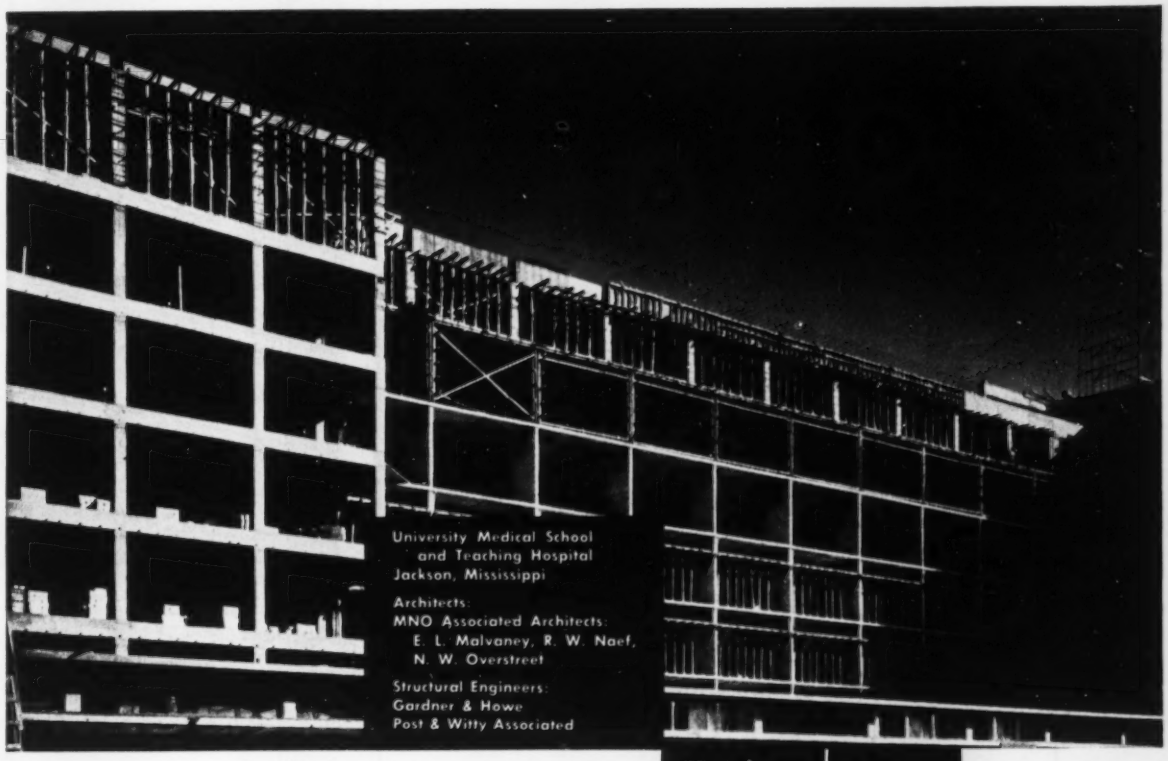
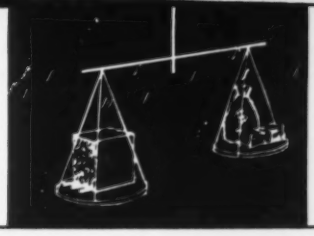
"we know that REINFORCED CONCRETE is less expensive and better"



University Medical School
and Teaching Hospital
Jackson, Mississippi

Architects:
MNO Associated Architects:
E. L. Malvaney, R. W. Naef,
N. W. Overstreet

Structural Engineers:
Gardner & Howe
Post & Witty Associated



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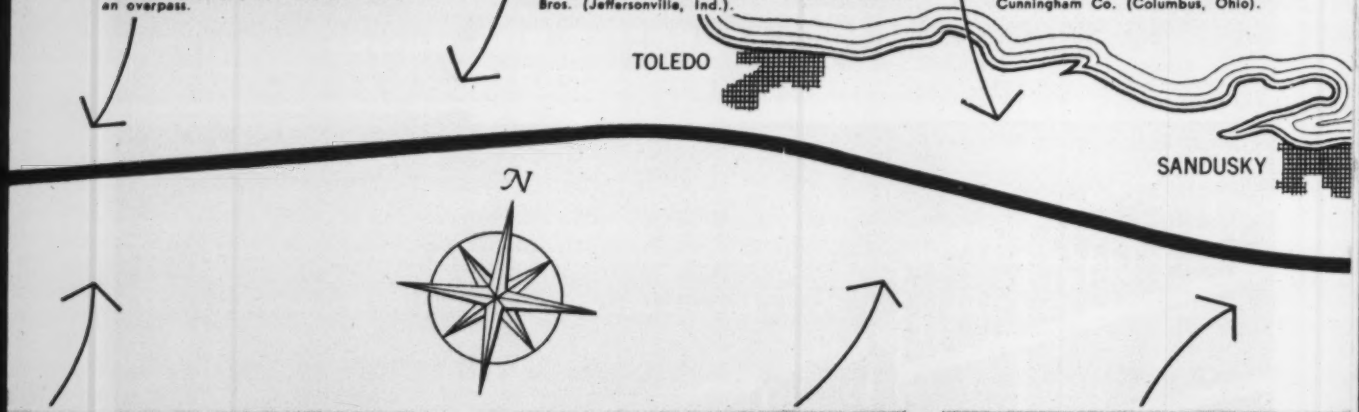
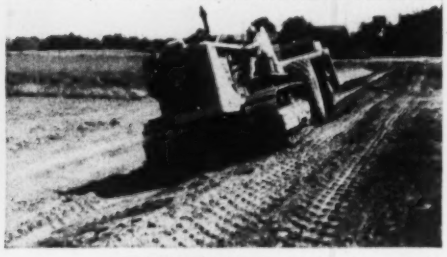
CLEARING! D318 powers dragline for S. J. Groves & Sons (Elyria, Ohio) pioneering for an overpass.

SAND! DW21 with No. 21 Scraper pulls out of borrow pit of wet sand for J. E. Pirtle & Tanner Bros. (Jeffersonville, Ind.).

CLAY! DW21 is push-loaded by D8 for Peter Kiewit Sons' Co. and Condon-Cunningham Co. (Columbus, Ohio).



MUD! D8 equipped with No. 8A Bulldozer working in clay at overpass for V. N. Holderman & Sons (Columbus, Ohio).



DRAINAGE! D8 with No. 80 Scraper maintains ditch alongside fill on Winston Bros. Co. (Minneapolis) contract.

HAUL ROADS! No. 12 Motor Grader maintains road for Holloway & Thompson Construction Co. (Livonia, Mich.).

Over 50 contractors are pushing the nation's newest turnpike to completion through sand, bog, clay and rock. As one man, they've turned to big yellow equipment. Eighty-five per cent of their crawlers, 83% of their motor graders are Caterpillar—over 650 pieces of earthmoving equipment in all!

The roster of contractors at work on the Ohio Turnpike reads like a blue book of America's road builders. And from one end of this $326 million road to the other, they have given Caterpillar the biggest vote of confidence in road building history.

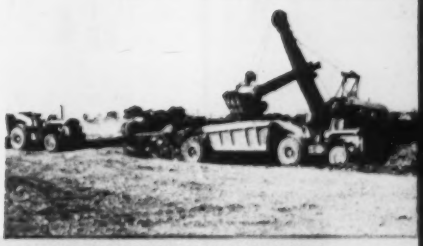
Collectively they have more than 650 pieces of Caterpillar-built earthmoving equipment on the job—and that doesn't include scores of CAT* Diesel Engines and Electric Sets. *They have far more Caterpillar equipment at work than all the other makes put together!*

Yet there is no pattern in the type of work being done by this tremendous fleet of Caterpillar equipment. For on its 241 miles, the Ohio Turnpike presents every possible type of terrain and soil—from river bottom to mountains, from quicksand and bog to clay and rock.

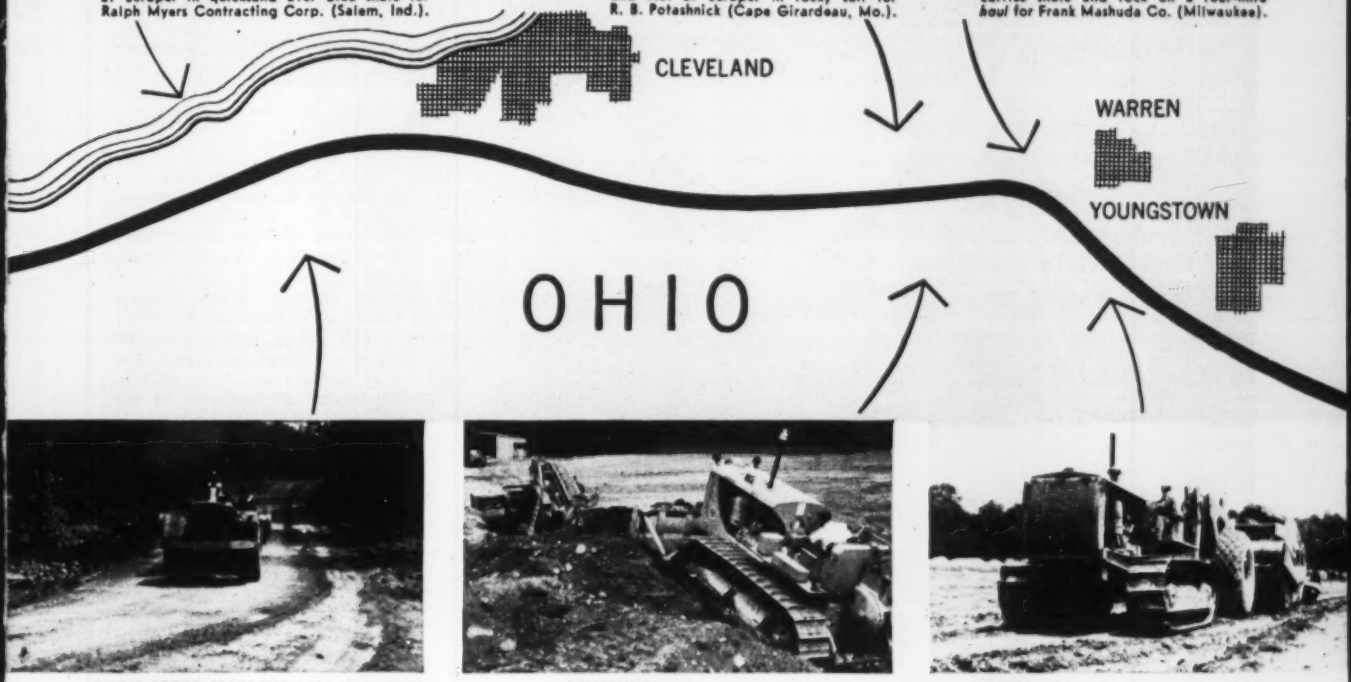
on the Ohio Turnpike
Caterpillar

QUICKSAND! D8 push-loads DW21 and No. 21 Scraper in quicksand over blue shale for Ralph Myers Contracting Corp. (Salem, Ind.).

ROCK! D8s in tandem push-load DW21 and No. 21 Scraper in rocky soil for R. B. Potashnick (Cape Girardeau, Mo.).



LONG HAULS! DW20 with W20 Wagon carries shale and rock on a *four-mile haul* for Frank Mashuda Co. (Milwaukee).



HIGH-SPEED HAULING! The first DW21 ever built still does high-speed hauling for Nick Cenci & Sons (Columbus, Ohio).

CRUSHING! D8 loads portable gravel plant powered by D337 for W. J. Menefee Construction Co. (Sedalia, Mo.).

GUMBO! No. 90 Scraper, pulled and push-loaded by D8s, works in gumbo for Harrison Construction Co. (Pittsburgh).

It is an amazing demonstration of the versatility of big yellow equipment. There are 450 Cat track-type Tractors alone — *346 are D8s!* That represents 85% of all the crawlers at work on the project. Eighty-three per cent of the motor graders at work are Caterpillar, and 60% of the rubber-tired tractor-scraper units.

Heavy-duty, dependable Cat Diesel Engines are powering draglines, clamshells, shovels, backhoes, crushers, compressors, loaders. And through long, dark second shifts, Caterpillar Electric Sets are producing the electricity for flood-lighting and contractors' service shops.

Never before has there been such a testimonial to one make of equipment as this 650-unit fleet. Now's the time to follow the lead of road building leaders.

Start standardizing on Caterpillar equipment!

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For bringing in water, for getting rid of water, and for putting water to work on construction jobs, there's no better vehicle than Naylor light-weight pipe. The big difference between this and other light-weight pipe is in Naylor's exclusive lockseamed-spiralwelded structure which adds strength and safety without added weight. And this light weight makes for easier handling and easier installation—particularly with the one-piece Naylor Wedge-Lock coupling to speed connections and simplify the job. Why not look into this pipe and coupling combination? Ask for Bulletins No. 507 and No. 513.

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Deceased

(*Continued from page 94*)

William Hubert Vincent (A.M. '13), age 68, job engineer for the R.F. Ball Cone Co., San Antonio, Tex., died on April 26. From 1928 to 1937 Mr. Vincent was resident and bridge locating engineer for the Louisiana State Highway Commission at Slidell, Mandeville, and New Orleans. In recent years he was engaged on engineering projects in Mississippi and Texas. He graduated from Tulane University and did post-graduate work at Harvard University.

Maurice Alvin Warthen (A.M. '30), age 62, assistant inspector of buildings for the District of Columbia government for the past 15 years, died at his home in Washington, D.C., recently. Employed in the Washington area since 1918, Mr. Warthen had been with the U.S. Engineer Office, Geo. Hyman Construction Co., Louis E. Luria Co., Inc., Grier-Lowrance Construction Co., and the Public Works Administration. He attended the Baltimore Polytechnic Institute.

Lewis Daniel Williams, Jr. (M. '31), age 68, for the past 24 years engineer and manager of the Port of Willapa Harbor, Raymond, Wash., died in March 1954. Mr. Williams had been with the Ilwaco and Chinook (Wash.) water systems, and was assistant engineer on the Astoria (Oreg.) Reclamation Project. He was a member of McClean & Williams, Astoria engineering firm engaged in highway and water works construction, from 1921 to 1926, and owner and operator of the Mountain Springs Water Co., Long Beach, Wash., from 1926 to 1930. He attended the University of Washington.

New Publications

Equipment Operation. Availability of a deluxe field edition of Herbert Nichols' 150-page book on *How to Operate Excavation Equipment*, which was reviewed in the May issue (page 114) is announced by the publisher, North Castle Books, 212 Bedford Road, Greenwich, Conn. The special edition is bound in leatherette and sells for $3 (or $4 with the owner's name stamped in gold). Cloth-bound copies are $2.50, and paper-bound copies $1.50.

Roadside Equipment. Different types of roadside equipment in successful use in 22 states are described by the Highway Research Board in Special Report 16. Entitled *Mechanization of Roadside Operations*, the illustrated bulletin reports the result of a canvass conducted by the Board to determine the types of equipment found most useful and economical. The publication sells for 60 cents, and may be purchased from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Manpower Utilization. Material of practical import for everyone concerned with the effective utilization of engineering and scientific manpower is now available in the proceedings of a conference

(*Continued on page 100*)

Leffel

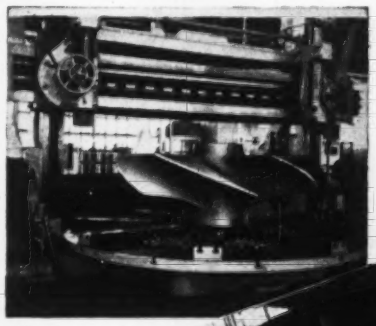
HYDRAULIC TURBINE

increases

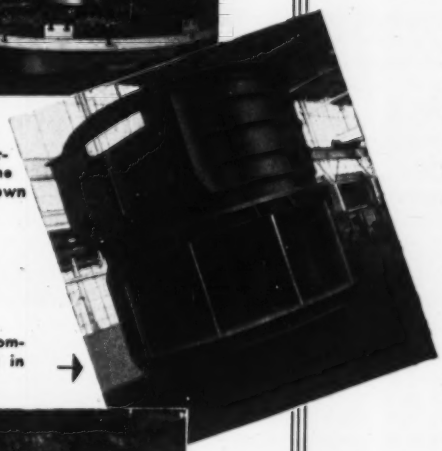
power output at

WILBUR DAM

of the Tennessee Valley Authority



Cast steel propeller-type runner for the Wilbur turbine, shown on boring mill.

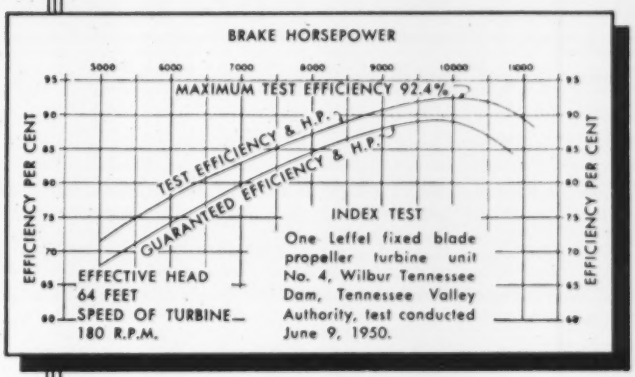


Wilbur turbine, completely assembled in the Leffel plant.

Lifting the combined runner, shaft and cover-plate during the field installation.

The Wilbur power project of the TVA is another instance where a Leffel hydraulic turbine was used for the expansion of existing power facilities. For the Wilbur installation a Leffel vertical propeller-type hydraulic turbine was used — maximum rated at 11,500 HP, under 67 feet net head, speed 180 RPM.

The Wilbur project demonstrates once again that the long-range economy and dependability of Leffel turbines make a valuable asset for any expansion or rehabilitation. Our facilities are backed by 91 years of reliable service to the water power industry. Why not let us help you with your project, whether it be expansion, rehabilitation or a new installation?



Field Test Results

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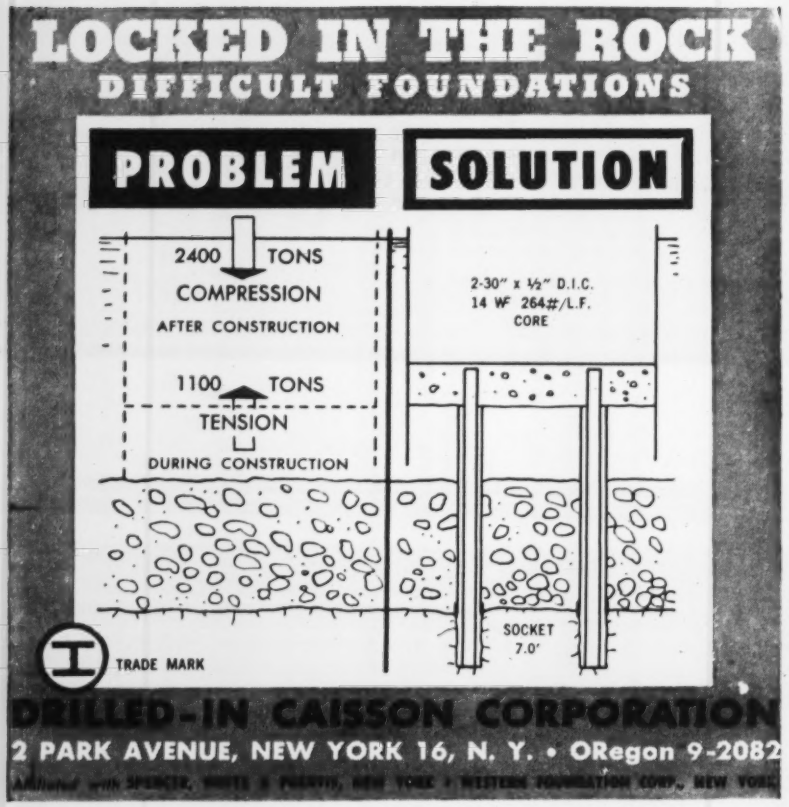

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New Publications

(*Continued from page 98*)

sponsored by the National Manpower Council on the Harriman campus of Columbia University in October 1953. The 200-page volume, entitled *The Utilization of Scientific and Professional Manpower*, has been published by the Columbia University Press, Columbia University, New York, N.Y. It sells for $3.50.

Cement and Concrete. A compilation of interesting facts on the history, manufacture, and uses of portland cement and concrete—one of the most varied materials in the construction field—constitutes the Portland Cement Association's *1954 Cement and Concrete Reference Book*. The 110-page reference, illustrated with views of processes and projects, covers a wide range of structural uses, special uses, precast concrete products, etc. Inquiries should be addressed to the Portland Cement Association, 33 W. Grand Ave., Chicago 10, Ill.

Concrete Research. Another in the series of technical memoranda describing laboratory studies made by the Waterways Experiment Station is now available. The present memorandum (No. 6-371) describes investigations of a number of concrete dams, in which the aggregates in whole or in part are limestone. The investigation was accomplished by the Concrete Research Division under the supervision of Charles E. Wuerpel, M. ASCE, and Herbert K. Cook. The report was prepared by Bryant Mather, F. J. Callan, Katherine Mather, and Nelson B. Dodge. Copies may be purchased from the Waterways Experiment Station, Vicksburg, Miss., at $1.50 each.

Power and Fuel, Japan. The U.S. National Committee of the World Power Conference announces the availability of the 1954 Japan Power and Fuel Year Book. Edited and published by the Japan Power Association, a group closely connected with the Japanese National Committee of the World Power Conference, the book gives a comprehensive picture of the electric power, coal, petroleum, and utility gas industries; the power machine industries; and such major power-consuming activities as the iron and steel, pulp and paper, and cement industries. Copies at $6 each may be obtained, postage prepaid, from the Japan Power Association, Nippon Kogyo Club Building, Marunouchi, Chiyoda-ku, Tokyo, Japan.

Shopping Districts, Rehabilitation. Many older business districts that are disintegrating rapidly in the face of competion from new outlying shopping centers can be rehabilitated successfully and economically, if municipalities, owners, and tenants will adopt realistic conservation plans, according to Technical Bulletin No. 22, just issued by the Urban Land Institute. A plan for conservation and rehabilitation of such districts is set forth in the bulletin, which is entitled *Conservation and Rehabilitation of Major Shopping Districts*. Copies may be purchased from the Urban Land Institute, 1737 K St., N.W., Washington 6, D.C., for $5 each.

Coastal Engineering. Proceedings of the Fourth Conference on Coastal Engineering, held in Chicago in October 1953, have been released by the Council on Wave Research of the Engineering Foundation. The Illinois Section of ASCE was one of the local groups supporting the conference, which was sponsored jointly by the Council on Wave Research and the Technology Institute of Northwestern University. The 400-page illustrated PROCEEDINGS sells for $5, and may be obtained from the Council on Wave Research, 244 Hesse Hall, University of California, Berkeley 4, Calif.

[*Editor's Note:* The 113-page *Glossary of Terms and List of Standard Symbols* pertaining to waves, tides, currents, and beaches—prepared by the Council on Wave Research of the Engineering Foundation and reviewed in the May issue—sells for $1 and may be obtained from the Council on Wave Research, 245 Hesse Hall, University of California, Berkeley 4, Calif. Orders should not be sent to the Engineering Foundation headquarters in New York.]

(*Continued on page 102*)

MAYO
PNEUMATIC GROUTER and "PEA SHOOTER"

The Mayo Pneumatic Grouter has performed capably on jobs ranging from tunnels, mines, and shafts to foundations and railroad subgrades. Simple and efficient in operation, it may also be used for injecting chemical soil stabilizers into caving or running ground.

For grouting back of lagging in rock tunnels or back of liner plates in soft ground, the Mayo Grouter is readily converted to a "Pea Shooter" for shooting Pea or "Bird's Eye" gravel.

The Mayo Pneumatic Grouter has no moving parts within the Grout . . . gives years of trouble-free service. Shop tested to twice working pressure. Capacity: 3½ cu. ft., charging height: 3 ft. Weighs approximately 700 lbs., and occupies 22 cu. ft. space.

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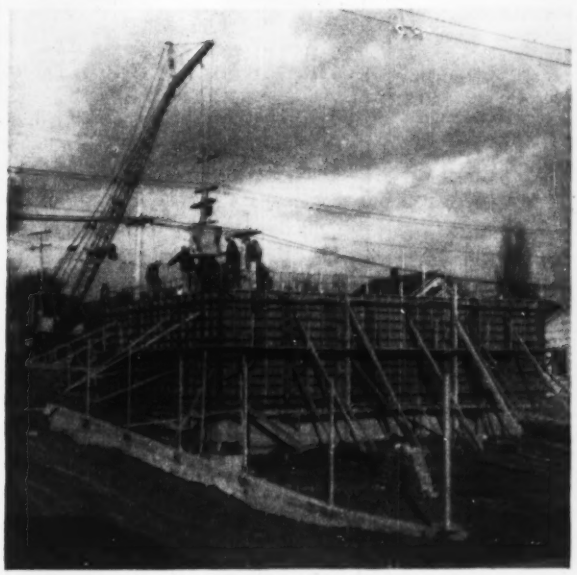

First of four rectifier buildings for City Light, Seattle. C & R Builders, Seattle and Alaska, Gen. Con.

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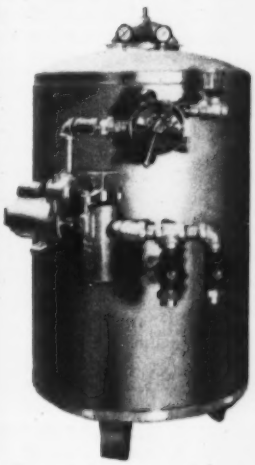

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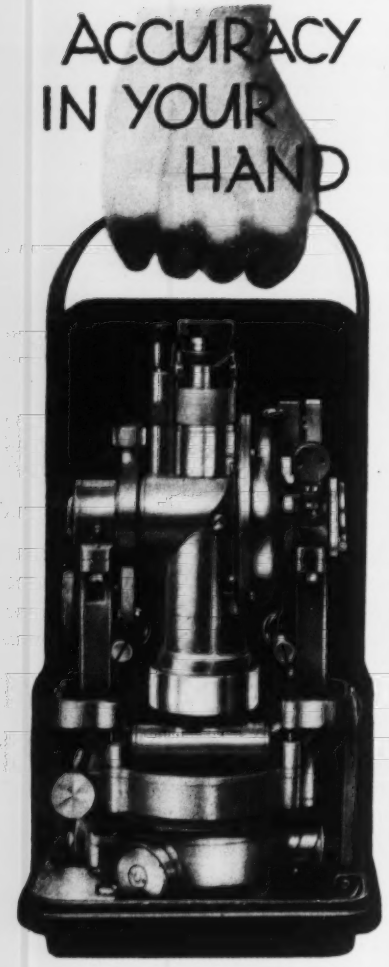

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New Publications

(Continued from page 100)

Snow Removal. Recommended practice for snow removal and treatment of icy pavements is made available in the third revision of No. 9-3R in the Current Road Problems series issued by the Highway Research Board. Copies of the 20-page illustrated bulletin may be purchased from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C., at 30 cents each.

Positions Announced

U.S. Civil Service. Announcement is made by the U.S. Civil Service Commission of an examination for the position of City Planner (GS-7 to GS-15) in Washington, D.C., and nearby areas. The salaries range from $4,205 to $10,800 a year. To qualify, applicants must have had appropriate education or technical experience, and successful professional experience in city or regional planning. For detailed information regarding requirements and application procedure, write to the U.S. Civil Service Commission, Washington 25, D.C., for Announcement No. 410, issued June 29, 1954.

City of Burbank, Calif. Applications for the position of planning director, at a salary ranging from $696 to $894 a month, have been invited by the Civil Service Department of Burbank, Calif. Requirements include California residence, a degree from an accredited college, and five years of planning experience in a city or county planning department—of which two years must have been spent in supervision of technical personnel and responsibility for a major segment of the planning program as a planning director or assistant planning director. Examinations will be held in Los Angeles or Burbank at a date to be announced. Additional information and applications may be obtained from the Civil Service Department, City Hall, Burbank, Calif.

Engineer Center, Fort Belvoir. Vacancies for the post of Civil Engineer (GS-7 and 9) at an annual salary of $4,205 to $5,060, are announced by The Engineer Center at Fort Belvoir, Va. Applications for federal employment, Standard Form 57, obtained from a Civil Service or Department of the Army Civilian Personnel Office, should be mailed to Civilian Personnel Division, Employee Utilization Branch, Building 211, Room 200A, The Engineer Center, Fort Belvoir, Va.

Naval Air Missile Test Center, Point Mugu. Applications are now being accepted for positions at the U.S. Naval Air Missile Test Center at Point Mugu, Port Hueneme, Calif. Among the openings listed in a recent bulletin are those for General Engineer (GS-9, 11, 12, and 13) with a salary ranging from $5,060 to $8,360 a year; Industrial Engineer (GS-7) at $4,205; and Publications Editor (GS-5, 7, and 9) at salaries from $3,410 to $5,060. More detailed information is available from the U.S. Naval Air Missile Test Center, Point Mugu, Port Hueneme, Calif.

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THE ENGINEER'S CREED

The American Society of Civil Engineers announces the availability of a new supply of "The Engineer's Creed," which originally appeared in the November, 1948 issue of CIVIL ENGINEERING. This new de luxe reprint, 8½ x 11", has been produced on lightweight parchment, and is suitable for framing.

Copies available at $1.00 each
Quantity prices on request

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Please send me . . . copies of "The Engineer's Creed"
Payment is enclosed herewith

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City.....

THE "ALL AMERICAN" CITY

CANTON, OHIO

CHOOSES "Flexibles" OF COURSE

Last year Canton was named an "All America" City by the National Municipal League and LOOK Magazine, being one of 11 cities so designated during 1953. It received a merit certificate for outstanding achievement in city government among other honors and recognition.

Naturally, like other modern, well-run cities, Canton uses and endorses "Flexible" sewer cleaning equipment. Pictured is one of its "Flexible" Bucket Machines in the process of getting a sizeable heap of mud and other obstructions out of a typical sewer manhole. Floyd Walters is operating, Ralph Swinehart is dumping the bucket, Don Skotnicky is standing by. They are working in safety and with dignity above ground on the street level... instead of "in the sewers," as was required of sewer maintenance crews in the years "Before Flexibles."

"Flexibles" cut sewer cleaning costs – permit preventative maintenance to be carried out – operate in all weather. There is a model for every need. We invite the opportunity to give your city an "on the job demonstration."

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speed reducers.....many types	sykes herringbone gears....diameters up to 60 inches
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spur gears.....diameters ⅜ inch to 34 feet	worm wheels.....diameters up to 98 inches
bevel and miter gears..diameters ½ inch to 165 inches	worms.....made in any size
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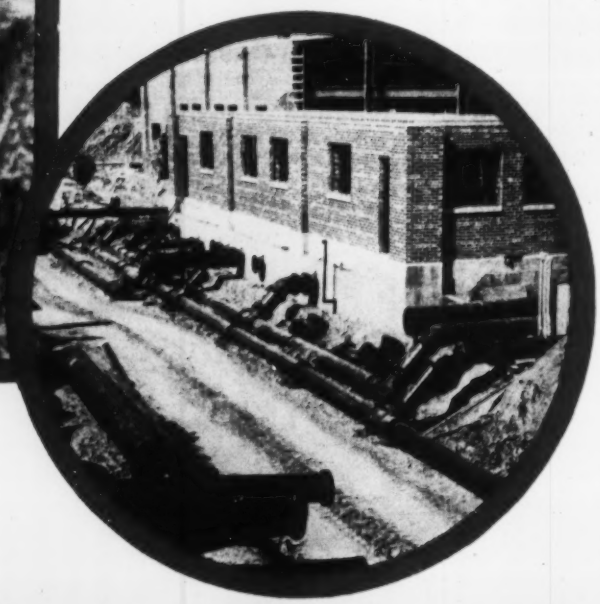
racks (straight or curved).....made in any size

For TOUGH assignments

When pipe is to be installed under conditions which make repairs difficult at best, the engineering profession relies on cast iron pipe. Such installations, for example, as outfall sewers, river crossings, and sealed piping in sewage treatment and water filtration plants. *Any* installation, where repairs should be a remote possibility, calls for rugged cast iron pipe. Its great beam-strength, compressive-strength and shock-strength—plus its effective resistance to corrosion—result in long life with negligible repairs and maintenance cost. For information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

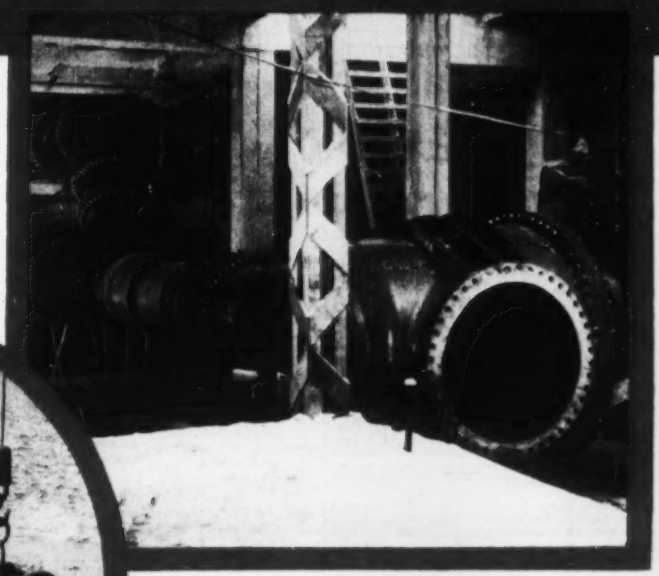


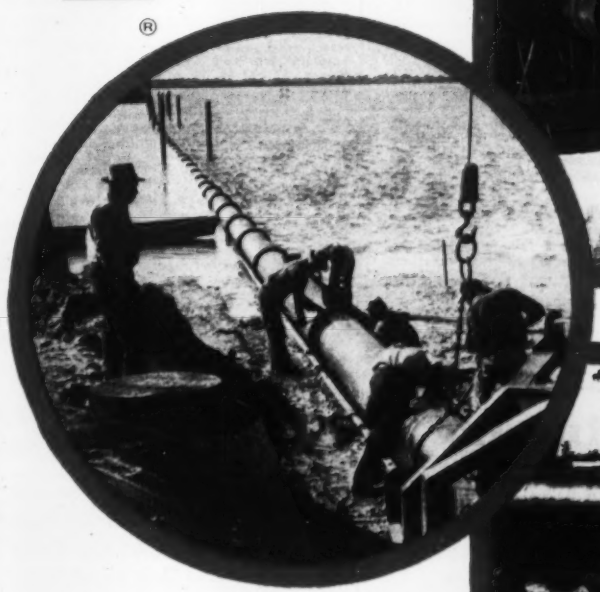
(above)
Installing cast iron belt feeder main for water supply system in Casper, Wyoming.

(right)
Cast iron pipe for discharge lines from water circulating pump house in a midwest oil refinery.

CAST IRON PIPE

use this RUGGED pipe





(above)
Cast iron pipe for outfall into St. Joseph Sound from sewage disposal plant at Dunedin, Fla.

(top right)
Cast iron pipe and fittings installed in world's largest water filtration plant in Chicago, Ill.

(at right)
Installing 30" cast iron pipe for sewage treatment plant at Panama City, Fla.

SERVES FOR CENTURIES...

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All applications should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL AND STRUCTURAL ENGINEER; A. M. ASCE; 41; married; experienced all phases project planning, design and supervision, including estimates and specifications, report writing and economic analyses. Port and harbor development, heavy construction, foundations, hydraulics, prestressed concrete; field surveys and investigations, hydrographic surveys. Recent experience in Latin America. Will relocate. C-983.

CIVIL ENGINEER; J. M. ASCE; 29; married; Registered Professional Engineer; B.S.C.E.; M.S.C.E., major in structures; 1 year structural design; 3 years' varied construction experience as engineer and estimator for construction company; 2 years' field and office experience as resident officer in charge of construction in Navy (rank, Lt., CEC, USNR); desires responsible position with consulting firm doing prestressed concrete design or with an engineering and construction company. Location preferred, middle West. Available, October, 1954. C-984.

CIVIL ENGINEER; J. M. ASCE; 27; married; B.S.C.E., Lehigh University, 1952; presently on active duty with Corps of Engineers, U. S. Army. Desires responsible position in field and/or design work. Available mid-October, 1954. Locations preferred, Northeast or Midwest. C-985.

MUNICIPAL MANAGER AND ENGINEER; A. M. ASCE; 36; married; BSCE 1940; Army officer with 13 years' service; past 6 years as military post engineer directing municipal management, planning, and engineering of large Army installations. Desires position as city manager or engineer of southern or southwestern municipality. C-986.

CIVIL ENGINEER; J. M. ASCE; 25; married; B.C.E. 1951; 3 years' experience in design and construction. Mexican citizen, fluent English and Spanish; prefers foreign assignment, Mexico, Central or South America in field superintendence or structural design. C-987-SF-2-4.

CIVIL ENGINEER; A. M. ASCE; 51; married; 25 years' experience of which 20 years in water resources investigations and reports, overall design of multiple purpose water projects, heavy construction; 7 years' highway work in Middlewest. Location preferred, California; will consider other Pacific Coast locations. C-988-SF-2-5.

Positions Available

INSTRUCTORS, young, preferably with M.S. degrees, to teach surveying and transportation. Positions start September 1954. Salary, $4,200–$4,500 for 9 months. Location, Midwest. Y-9836.

CONSTRUCTION ENGINEERS. (*a*) Construction Engineers with experience in the construction of roads in both mountainous and flat terrain. (*b*) Construction Engineers experienced in all types of asphalt pavement. Ability to speak Spanish an asset. Location, Venezuela, S. A. F-9894.

ADMINISTRATIVE ENGINEER, civil, mechanical or chemical graduate, with 7 to 15 years' experience in a gas utility field and must be capable of directing engineering activities, as well as evaluating operating methods and results. Salary open. Location, Connecticut. Y-9895.

FIELD ENGINEER, civil graduate, with highway, street and municipal engineering experience for field and office work with contractor. Salary, $5,200–$6,500 a year. Location, Philadelphia, Pa. Y-9954.

SENIOR BUILDING CONSTRUCTION ENGINEER, licensed professional engineer, with construction experience. For a major building program which will involve construction of several new institutions and reconstruction of existing facilities. Salary, to start, $6,088 with five annual increments. Location, New York State. W-27.

HIGHWAY ENGINEER, 30–40, at least 10 years' highway experience including responsible charge in important positions for at least 3 years. Must be able to write clear reports and to make effective oral presentations to both technical and lay groups. Position requires some traveling. Headquarters in eastern city. W-107

TECHNICAL ASSISTANT TO CHIEF OF PLANNING DIVISION, graduate civil, about 40. Should have 5 years' experience in preparing and completing preliminary and basic studies and layouts of hydroelectric developments; analyzing and evaluating hydrological, topographical and geological data with relation to power development studies; determining survey work required. Should have some teaching experience. Salary open. Location, Brazil. F-135.

PROJECT ENGINEER, civil, preferably with professional engineer's license and at least 10 years' experience in sanitary engineering, to make survey of municipal sewer system, plan improvements and additions and prepare reports. Salary open. Location, New York, N.Y. W-141.

ASSISTANT CONSTRUCTION ENGINEER, young, civil, for general inspection work on pavement, buildings and other structures; liaison between construction engineering and consulting engineers. Salary, $5,100–$5,400 a year. Location, New Jersey. W-142.

CONCRETE TECHNICIAN, graduate civil engineer, with minimum of 5 years' experience including testing, mixing, inspecting concrete in connection with large hydroelectric job in Brazil. Two years work. Salary, $7,000–$8,000 a year, plus living expenses. F-162.

JUNIOR ENGINEERS, civil, mechanical, ceramic or mining graduates, for training program in cement industry, both sales and plant engineering. Locations, New York, N.Y., Pennsylvania and Midwest. W-198.

EARTHWORK ENGINEER, 10 years' experience in earthwork design of airports, airfields and highways. Must also have at least 5 years' experience in responsible charge of work. Salary, $10,500–$11,750 a year, plus $5 per diem cost of living; 18-month contract. Location, Europe. F-211 (*a*).

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering department; B.S. or M.S. degree, with or without teaching experience. Should be able to teach soil mechanics, hydraulics, water supply and sewerage, highway design and plain concrete. Salary, about $4,000 for 9 months. Location, West. W-221.

CONSTRUCTION ENGINEER, 30–35, who has had some experience laying pipe lines, preferably cast iron. The job would entail considerable traveling, supervising the installation of the company's product. Salary, to $10,000 a year. Location, East. W-229.

ASSISTANT MANAGER, 20–35, for general building contractor on earth work, sewer installations,

STATE ROAD DEPARTMENT OF FLORIDA
TRAFFIC AND PLANNING ENGINEERS

To accept responsibilty for traffic engineering and geometric design with but little supervision. No knowledge of signs and signals required.

Qualifications: Age 30-50 with a B.S. degree in Engineering, or equivalent experience; some experience in traffic surveys and origin and destination analysis; those with some experience in design preferred.

Starting salary will range from $300 to $400 per month depending upon experience.

For further information contact:

M. A. Conner
Engineer of Traffic & Planning
State Road Department
Tallahassee, Florida

Engineer Editor Wanted

Civil engineering graduate with road, street or bridge engineering or construction experience.

Excellent career opportunity with old established publishing firm for engineer who has shown article or report writing aptitude.

Age 28-40. Midwest headquarters. Reply will be kept in confidence. Tell us your qualifications and salary requirements.

Address reply to Box 235
Civil Engineering
33 West 39th Street
New York 18, New York

CITY ENGINEER

City of Montebello, California (pop. 25,000) invites applications. California registration with one year of experience in municipal government in administrative capacity. Salary range — $629 – $703. Maximum age 65. Apply by September 1, 1954 to

Personnel Officer, City Hall, 140 North Sixth Street, Montebello, California.

civil engineer

Large New York engineering and construction firm desires graduate civil engineer with at least 10 years experience in layout and design of hydroelectric developments. In addition, applicant should have broad experience in design of heavy foundations.

Work includes planning, supervision of design, writing of specifications, and requisitioning of material.

This is a staff position offering starting salary commensurate with experience.

Please submit resume including personal data, ducation and experience to:

BOX 234

Civil Engineering
33 West 39th Street
New York 18, N. Y.

water installations, curb and roads on large housing projects. Experience with earth moving and road building machinery helpful, but not essential. Location, Pennsylvania. W-231.

INSTRUCTOR, general engineering, to teach primarily drawing and descriptive geometry. Candidates must have engineering degree and be eligible to enter graduate college. Salary commensurate with training and experience. Previous teaching experience not required. Position permanent with opportunity for advancement. Location, Illinois. C-2026.

Applications for Admission to ASCE, June 12–July 10

Applying for Member

MARVIN OFELT ANDERBERG, Seattle, Wash.
MAX HEDLEY ANDERSON, Helena, Mont.
CLEO WALTER BATES, Los Angeles, Calif.
JOHN BERNARD BOYANCHEK, Anchorage, Alaska.
DAVID LESLIE CHANEY, Washington, D.C.
LAVONNE EDWIN COX, Tullahoma, Tenn.
ARTHUR ROOT FIFE, Albuquerque, N. Mex.
JAMES CLARENCE FITCH, Chicago, Ill.
ORISON HERDMAN JEFFERS, Columbus, Ohio.
AUBREY ROGER KELLY, New York, N.Y.
ROSCOE REGINALD KROGER, Oakland, Calif.
KENNETH CLARK LAUSTER, New York, N.Y.
ROBERT JOSEPH MARTIN, JR., Binghamton, N.Y.
WALTER BAMFORD MCKENDRICK, JR., Dover, Del.
RAY ALONZO NIXON, Atlanta, Ga.
GUSTAVIO LEONICO RAMIREZ, Mexico, D.F., Mexico.
FRANK SANTILLI, New York, N.Y.
RICHARD WARREN TYLER, Baltimore, Md.
ELLIS EDMUND WILHOYT, JR., Savannah, Ga.
VICTOR DORIS WOLFE, Salem, Oreg.

Applying for Associate Member

CARLOS GOODWIN BELL, JR., Evanston, Ill.
DANIEL MICHAEL CASHDAN, New York, N.Y.
DONALD CHESTER CLENDENON, Carson City, Nev.
BRUCE HALCRO FALCONER, Wellington, New Zealand.
BENJAMIN EARL GAY, Savannah, Ga.
ABDUL HANNAN, Khulna, East Pakistan.
CLARENCE EDWARD HARE, JR., Baltimore, Md.
JAMES PIN HWANG, State of Brunei, North Borneo.
DAVID SOLOMON HYMAN, Baltimore, Md.
GEORGE WILLIAM KAY, Seattle, Wash.
WILLIAM HENRY KRANTZ, Port Hueneme, Calif.
FUAD SALIM MAAYEH, Dallas, Tex.
FRANCISCO ANTONIO MATUTE GUILLEN, Caracas, Venezuela, S.A.
WILLIAM JOSEPH MCCARTHY, Whiting, Ind.
LEON SHARP MILLER, Fort Worth, Tex.
VITO ALFRED NACCI, Providence, R.I.
JOHN RANDALL OWEN, New York, N.Y.
ROGER ALLEN REEVES, Denver, Colo.
ARCH FREEMAN REINHOLD, Van Nuys, Calif.
JOEL HERBERT ROSENBLATT, Bel Air, Md.
WILLIAM CALVIN SANDY, Clarksburg, W. Va.
FREDERIC STACEY SAUNDERS, JR., Redding, Calif.
HARRY EMANUEL SCHWARZ, Washington, D.C.
NUBAR SIVACIYAN, Ankara, Turkey.
PAUL ERNEST SONDERREGGER, Lincoln, Nebr.
BENGT SONESSON, Arlington, Va.
HUGO FRANKLIN SPROUL, Burbank, Calif.
STANLEY JOSEPH SYVWESTRAK, Chicago, Ill.
LOUIS JULIUS TANASSY, San Francisco, Calif.
WILLIAM GEORGE WEBER, JR., Sacramento, Calif.
THOMAS WILLIAM WEINHEIMER, Baton Rouge, La.
EDWIN BARTRAM WORD, Reading, Calif.

Applying for Junior Member

JOHN PICHLER BAILEY, Mechanicsburg, Pa.
JOHN NEDILCO CETINICH, Sacramento, Calif.
JOHN WILLIAM FERGUSON, North Hollywood, Calif.
ALAN MICHAEL FINN, Dorchester, Mass.
RAY WESLEY FOREAKER, JR., Berkeley, Calif.
DOUGLAS LEE GRAY, Portland, Oreg.
SAMUEL HOCHBERGER, Norfolk, Va.
CLYDE RICHARD HUSK, JR., Charleston, W. Va.
ERICH ARON KATZ, New York, N.Y.
KENNETH GORDON KNIGHT, Toronto, Ont., Canada.
NORMAN SHINN MATHIS, JR., Ventnor City, N.J.
BILLY JOE MCDONALD, Okland City, Okla.
LOUIE OLIVER MCFERON, New York, N.Y.
HOWARD LEONARD METCALF, Hampton, Va.
ALBERT WILLIAMSON ROLLINS, Dallas, Tex.
HUNGANAHALLI SAMANNA, Punjab, India.
AFIF MOHAMED SOUBRA, Chester, Mont.
RICHARD JAMES VASATKA, Mendota, Minn.

[Applications for Junior membership from ASCE Student Chapters are not listed.]

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Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

Proof of U. S. Citizenship Required

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GRUMMAN AIRCRAFT
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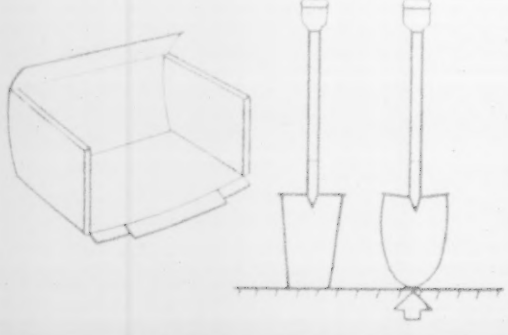
MR. CONTRACTOR: Compare these dirt-

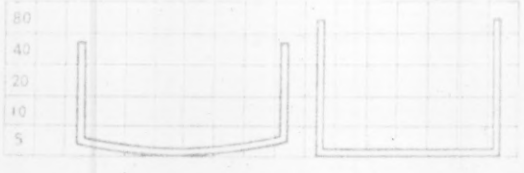
PENETRATES FASTER

Curved and offset cutting edge on Allis-Chalmers Motor Scrapers concentrates all the horsepower on the center section during initial penetration. The penetrating ability of a round-end spade helps illustrate the practical soundness of this Allis-Chalmers design.



LOADS FASTER

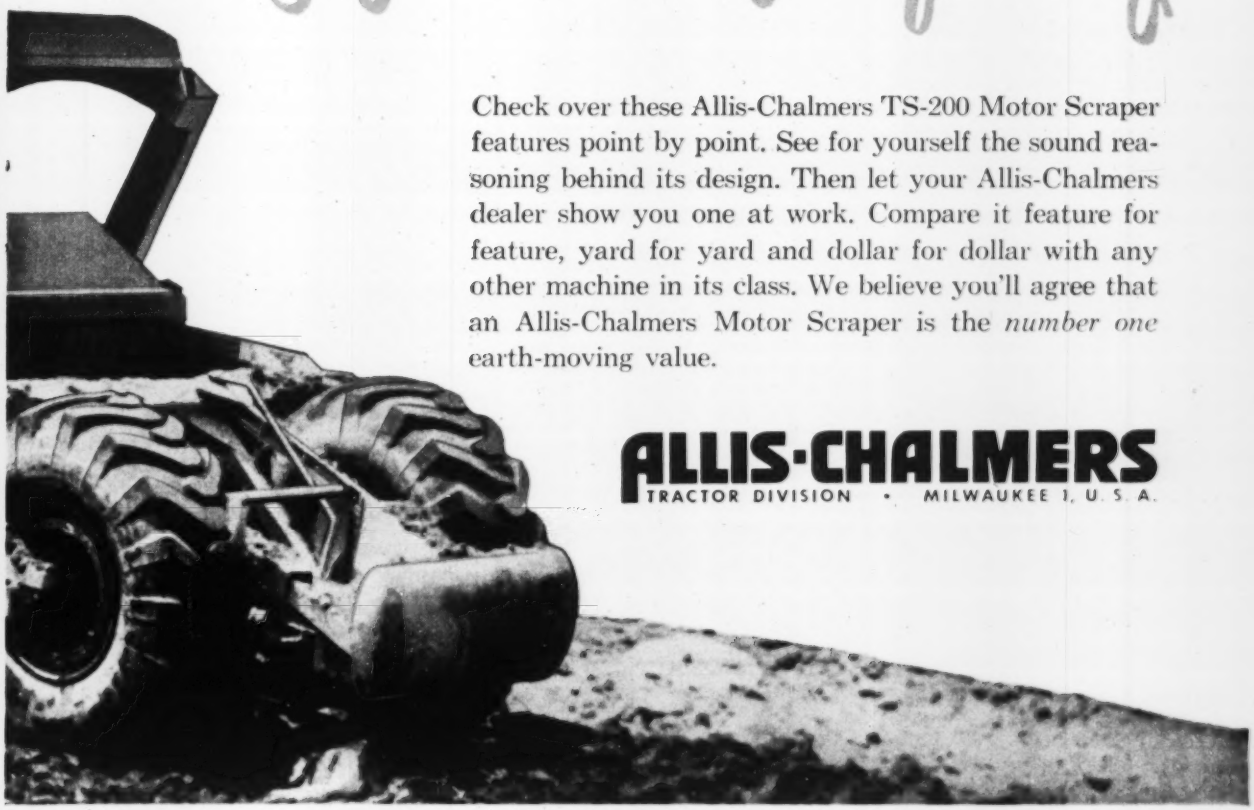
Low, wide bowl plays an extremely important part in ease of loading. Tests have proved that loading resistance is largely determined by the height to which the load is built. New dirt entering the bowl must lift the load directly above it in order to make room for itself.



This chart shows how loading resistance continually increases as the load builds up . . . how the lower, wider bowl of an Allis-Chalmers Motor Scraper requires less time and power to get the same yardage.

PERFORMANCE MAKES DOLLARS

moving features before you buy

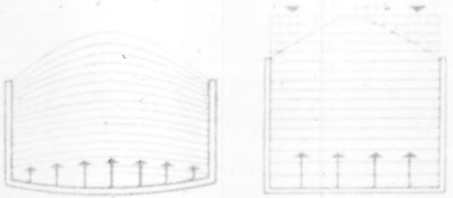


Check over these Allis-Chalmers TS-200 Motor Scraper features point by point. See for yourself the sound reasoning behind its design. Then let your Allis-Chalmers dealer show you one at work. Compare it feature for feature, yard for yard and dollar for dollar with any other machine in its class. We believe you'll agree that an Allis-Chalmers Motor Scraper is the *number one* earth-moving value.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

HEAPS AUTOMATICALLY

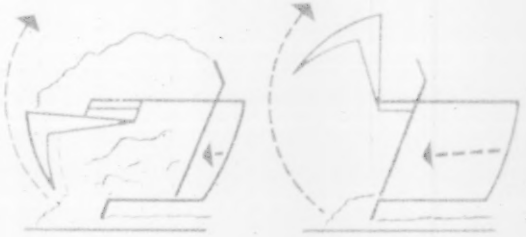
The combination of slightly deeper center cut and correctly angled cutting edge shapes the load as the scraper fills. The greater volume of dirt flowing into the center of the bowl "boils" forward, to the rear and to the sides, producing an automatically heaped load without excessive spillage.



These diagrams show how an automatically heaped load avoids costly spillage even though the center is built up above the sides of the bowl.

SPREADS EVENLY

Forward movement of ejector is timed with lifting action of apron, which provides a continuous flow of material to insure a smooth, even spread.



High apron lift prevents any possibility of material's jamming. Even when loaded from overhead, anything that can be put into the bowl can be easily ejected.

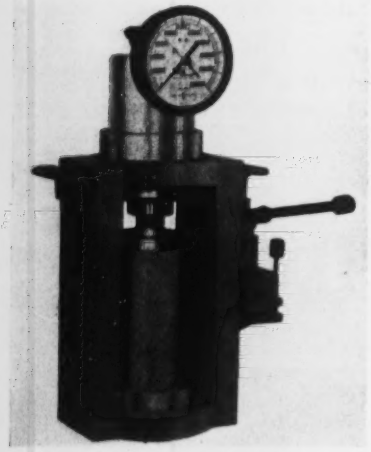
WHEN DESIGN MAKES SENSE

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Portable Testing Machine

A NEW PORTABLE 20,000 lb Testing Machine makes possible rapid on-the-job testing of concrete and similar materials with laboratory accuracy. The tester is entirely self-contained and no electrical or pressure connectors are required. It is



20,000 lb Testing Machine

simple to operate because loads are developed by means of a hand operated, two speed concentric pump which actuates the piston of the main hydraulic system. The Concrete Tester is equipped with a large direct reading gauge and a maximum load pointer. The Testing Machine can be rapidly converted to a 20,000 lb capacity flexure testing machine for beam tests. Use of the portable Testing Machine is not confined to concrete testing. It can be used as a high capacity shop or laboratory press, compression testing machine for casting or small vessels, experimental press for powdered metals work, and as a laboratory testing machine. **Soiltest, Inc., CE 8-110, 4520 W. North Ave., Chicago 39, Ill.**

Mechanical Pencil

A NEW MECHANICAL marking pencil called the "Marker" has been marketed. This instrument writes with ease on any surface such as glass, cans, bottles, china, cellophane, photographic negatives and surfaces that are normally hard to mark. Special features include all-metal working parts; a spring non-slip pocket clip and a propel-repel-expel mechanism that simplifies lead loading and adjusting. The leads are $2^3/_4$ in. long and 120 in. in diameter, and come in blue, red, yellow, green, black and black graphite. Priced at 29¢ the "Marker" is available at all stationery stores. **Eberhard Faber Pencil Co., CE 8-110, 37 Greenpoint Avenue, Brooklyn 22, N. Y.**

Model 240 Trencher

THE MODEL 240, a heavy-duty trenching machine for pipelines and similar heavy construction jobs has been introduced. It is a full-crawler-mounted, wheel type trencher which digs up to 36 in. wide and to 6 ft 3 in. deep. Its low ground bearing pressure of 6.3 lbs per sq in. is effective because the "240" is balanced perfectly at the center of its non-packing crawlers which are 100% anti-friction bearing equipped. This enables the "240" to work effectively in the wettest rights-of-way and overcome the toughest hills. The "240's" digging wheel employes a front upper truck. A rear upper truck (3 in. in dia) which is mounted on self-aligning bearings, supports the digging wheel entirely independent of the driving sprockets, provides smooth power-conserving digging action, and adds life to segments, sprockets, shafts, etc. The "kick-out" clutch permits stopping the crawlers without halting the digging wheels operation. Three optional bucket sizes give the "240" a trench width range from 20 to 36 in. Over-all length is $24^1/_2$ ft and road width is eight ft. It is powered by a 460 cu in. diesel engine delivering 64 hp at 1,200 rpm. Fifteen

Heavy-Duty Trencher

large capacity buckets are mounted on the digging wheel in three different series of bucket tooth patterns, providing increased digging efficiency and greater strength. **The Cleveland Trencher Co., CE 8-110, 20100 St. Clair Ave., Cleveland 17, Ohio.**

Dump Bodies

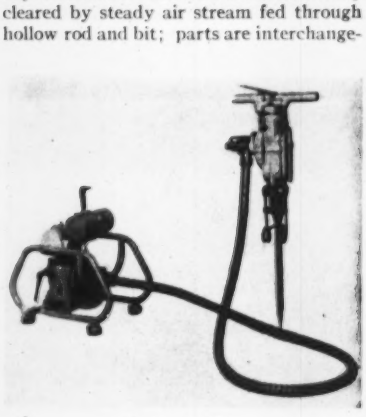
A NEW LINE OF contractor's truck bodies incorporating many new features is now available. This new four series Hercules line includes Series LD and WD Rugged Duty Bodies (standard lengths 12 to 17 ft), Series CD All-Purpose Bodies (standard lengths eight, nine, ten ft), and Series PL Solid Steel Platform Bodies for 60, 72, 84, 102-in. cab to axle trucks. These models are available in each line for use with Underbody and Telescopic Hoists. Load-carrier cab shields are available on Series LD, WD, and CD. **D. J. Redmond, Hercules Steel Products Corp. CE 8-110, Galion, Ohio.**

New Crane Gantry

A NEW TYPE GANTRY, known as a mast type gantry, will now be made available for Northwest Model 6 Cranes and Draglines. This gantry, which replaces the one formerly used on these machines, materially increases the ease and speed in lowering the gantry for low clearances when traveling or shipping. The gantry is extremely simple and rugged in design, and it is furnished with section boom hoist rigging with pendent lines. **The Northwest Engineering Company, CE 8-110, Chicago, Ill.**

Portable Drills

A NEW PRINCIPLE in the design of rock drilling, concrete breaking hammers is embodied in equipment recently introduced to the American market. Called Pinazza hammers, they are driven by a small, portable gasoline engine or electric motor through one or more flexible shafts. This means that the power drive can be compact and light weight enabling easy transportability. Rock drills are available in two sizes—the P60 weighing 35 lbs driven by 3.5 hp gasoline engine or electric motor; and the P70, weighing 49 lbs and driven by a 5.5 hp unit. The concrete breaking hammer, driven by either a 2.2 hp gasoline engine or a $2^1/_2$ hp electric motor (or by the same unit as used for the P60 rock drill drive) weighs 53 lbs. Evidence indicates that the Pinazza rock drills and concrete breakers are capable of handling the same work load as pneumatic hammers of equal weight. Other features are: simplicity in design resulting in lower costs; drilling may be done either wet or dry because the drill hole is automatically cleared by steady air stream fed through hollow rod and bit; parts are interchange-



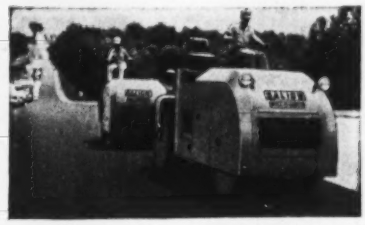
Pinazza Drill

able with standard American types; operating efficiency is not impaired at high altitudes; power units and hammer are separate, so hammer can be operated in any position. **Pitnam Industrial Products, CE 8-110, 608 Fifth Ave., New York 20, N.Y.**

Equipment, Materials & Methods (Continued)

Tandem Rollers

FOUR MODELS OF variable weight Tandem Rollers with their Roll-O-Matic Drive are now available. Roll-O-Matic Drive is an efficient combination of fluid drive and torque converter which automatically multiplies the engine driving force by means of oil instead of transmission gears. Power is never found lacking because more than twice the needed power is available, and tests show a savings up to 25% in fuel. This drive eliminates master clutch and gear shift mechanisms.



Galion Roll-O-Matic

Instead, the desired speed of the roller is selected and set by the operator with the control lever located at the side of the seat. After control lever is set, the engine adjusts itself to the driving power required. Uniform roller speed is closely and automatically maintained regardless of the grade or resistance encountered. This automatic action provides greater ease of handling, smoother operation, improved rolling quality, and reduced operator fatigue. It has been shown that all shockloads are absorbed by the fluid in the Roll-O-Matic Drive, thus increasing the life of the engine reversing mechanism, final drive gears, shafts, etc., up to 40%. Specifications list the Roll-O-Matic available on four size Tandem Rollers—5-8, 8-10½, 8-12 and 10-14 ton—with gasoline engine power. **The Galion Iron Works & Mfg. Co., CE 8-111, Galion, Ohio.**

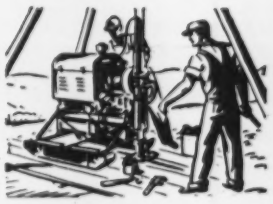
Renovataire

A NEW MACHINE, designed to both aerate and renovate roadsides, is now being built. Called the Renovataire, this machine has giant 22 in. renovating wheels built in pairs and individually suspended from the drawbar so as to provide a free floating differential action that will follow any contour, and at speeds up to five mph or more. Transporting is easily handled by a hydraulic lift frame for towing on highways. Saw-toothed knives, adjustable from two-three-four in. in depth, penetrate the soil with a slicing action and make two in. slits. There is no surface disturbance, and a minor amount of soil is extracted with each insertion. For worn out, compacted and eroded roadside slopes, parkways, grass islands or new seeded construction the Renovataire should be of great value in maintaining healthy turf by getting air, moisture and fertilizer down to the root zones. **Soilaire Industries, CE 8-111, 1208 2nd Ave., South, Minneapolis, Minnesota.**

Foundation Exploration

For more than sixty years, Sprague & Henwood, Inc. has been a leader in the field of Diamond Core Drilling, Soil Sampling, and other types of exploration for the foundations of Bridges, Dams, Large Buildings, Airports, Highways, etc., working in conjunction with many of the country's leading engineers and architects.

Today, we have a large force of expert operators and an ample supply of modern equipment, so that we can undertake practically any job, anywhere, on very short notice. Estimates submitted promptly — quick action when you want it.



On The New York State Thruway

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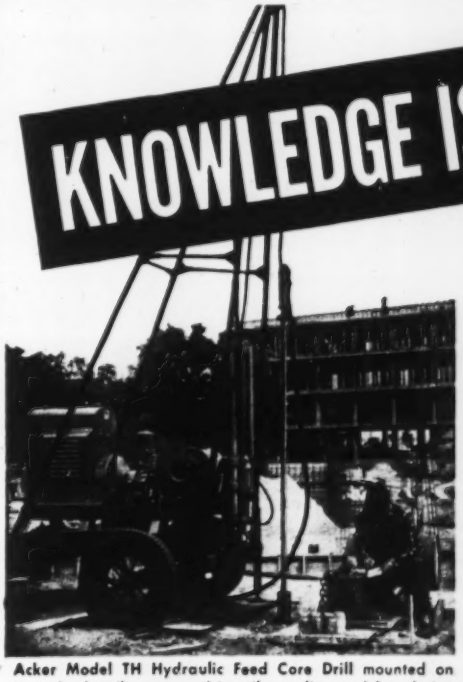

Acker Model TH Hydraulic Feed Core Drill mounted on two wheel trailer engaged in soil sampling and foundation test boring for a new building.

This Acker drill owned by a leading Southern University, is used not only for instructing engineering students, but commercial testing as well. In the latter capacity, it is in much demand by State governmental engineering departments for soil sampling and foundation test boring.

To see why Acker drills are preferred by leading engineers everywhere, write for Bulletin 30, CE.

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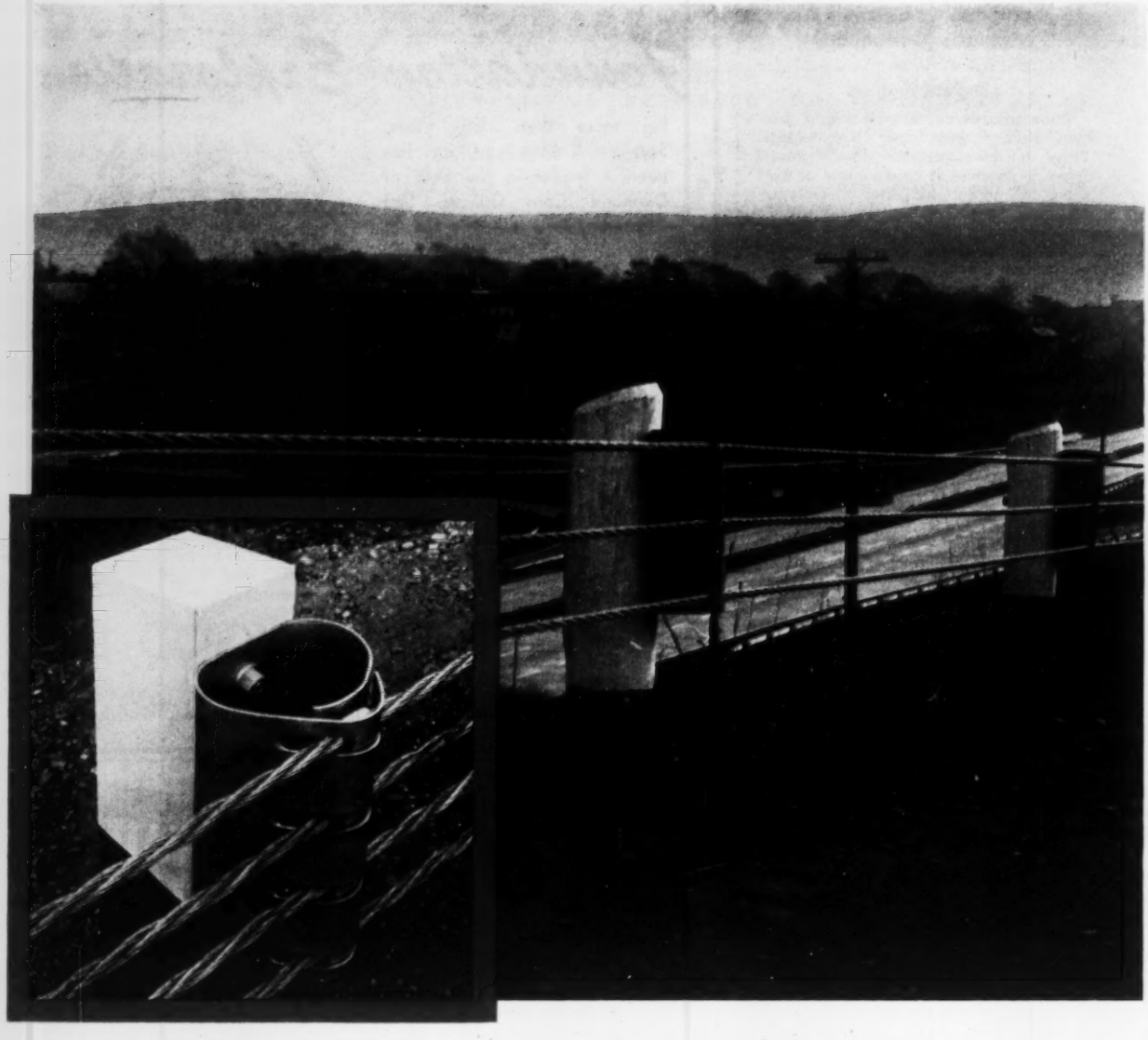

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THE highway engineers who designed and built this highway took no chances with safety. They designed the road surface for maximum safety. They set the speed limit at a safe value. Then, they specified an Amergard Highway Cable Guard that would guarantee adequate protection at that speed.

With Amergard, you can plan the safety of your highways to suit the range of speeds for which the road was designed. Three-cable Amergard gives adequate protection at impact speeds up to 55 mph. Four-cable Amergard protects up to about 75 mph.

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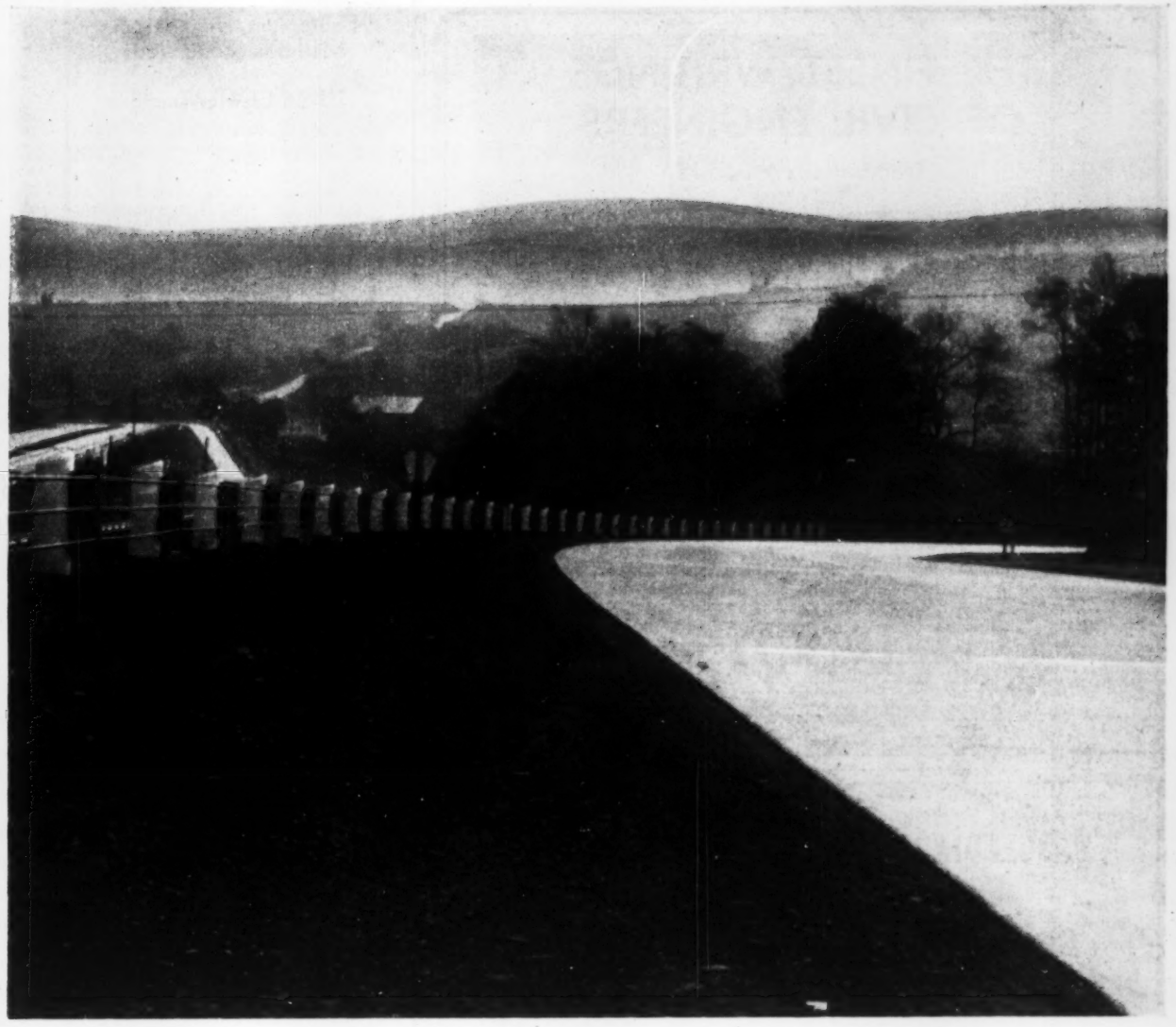

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USS Amergard Highway Guard

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Equipment, Materials & Methods (Continued)

TD-24 Crawler Tractor

AN INCREASED HP rating for the TD-24, largest crawler tractor in International Harvester's complete line of industrial power and earthmoving equipment, has been announced. The present production model of the TD-24 is rated at 190 engine hp and 155 drawbar hp. Maximum drawbar pull is rated at 40,000 lb and operating weight of the new model is 42,884 lb. The power plant for the TD-24 is the International D-1091 diesel engine with a bore and stroke of $5^{3}/_{4}$ x 7 in. and a rated governed speed of 1,400 rpm. This engine has inbuilt gasoline conversion starting and features synchromesh transmission with eight speeds forward and reverse. Planet power steering and hydraulic steering control, which were standard in previous models of the TD-24, are incorporated in the increased-power model. The TD-24 is designed to work with scrapers up to $27^{1}/_{2}$ cu yd capacity, angle blade dozers up to $14^{1}/_{2}$ ft, and straight blade dozers up to $12^{1}/_{2}$ ft. **Industrial Power Division of International Harvester Co., CE 8-114, 180 N. Michigan Ave., Chicago 1, Ill.**

Protective Covering

AN ALUMINUM COATING designed for protection of ferrous metals against atmospheric corrosion including salt spray and fumes is being introduced. The new coating, SEACO #342, requires no separate activators and is self curing at normal room temperatures. Applied, the coating resembles aluminum metal. If desired, it can be tinted to give a wide range of metallic colors with excellent color stability. It differs from most aluminum pigmented coatings since coating thicknesses of up to 0.002 in. per coat can be applied. The coating is elastic and has very low moisture or chemical permeability. Application is by brush, spray, or roller, and coverage is 170 sq ft per gal per 0.002 in. thickness. **Chemical Coatings & Engineering Co., CE 8-114, The Prucker Building, Darby, Penna.**

Low-Cost Carrier

A LOW COST 6×6 Crane Carrier—the Model 200, completely remanufactured for mounting of the Model T-35 Schield Bantam power crane-shovel, has been announced. The Bantum "200" features GMC six-cylinder engine, one-man cab, new brake system and steering gears, and a host of other new assemblies plus a reinforced main frame. The "200" carries a 60-day warranty against defective parts or workmanship. It has 40 mph road speeds, plenty of power to work in rough going (two transmissions offer ten forward speeds, two in reverse) with six-wheel drive to provide extra traction. The rig has short turning radius enabling owners to work with the rig in cramped quarters where space is at a premium. **Schield Bantam Co., CE 8-114, Waverly, Iowa.**

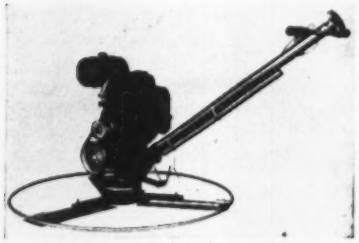
Equipment, Materials & Methods (Continued)

15 Ton Transit Crane

THE NEW 15-B Transit Crane—mobile-excavator with 15 ton rated lifting capacity—is now being offered. It is designed to handle fast and efficiently the many types of work now considered too small or restricted for profitable large machine operation. The mounting is powered by a 138 hp White gasoline engine, equipped with single wheels in front and tandem duals in rear with 170 in. wheel-base. A heavy duty five speed transmission mounted in unit with engine and two speed auxiliary unit mounted in truck frame combine to provide ten forward speeds and two reverse speeds. Standard equipment includes front and rear manually controlled telescoping outriggers. Standard crane boom is 30 feet long, extendible to 70 ft by using removable inserts. Boom suspension is of pendent type (8 part operating line between a frame and bridle). Power controlled lowering of the boom is fast and accurate. Hoisting and lowering are operated by a single hand lever, fully independent of all other functions. Conical hook swing rollers, operating along a double path to take both up and down loads, give free-running operation that increases ease of swing and also extends roller life. There are two pairs of large diameter rollers at the rear. Hook rollers eliminate the need for a center pintle and the heavy reinforcement necessary to support it. **Bucyrus-Erie Co., CE 8-115, South Milwaukee, Wis.**

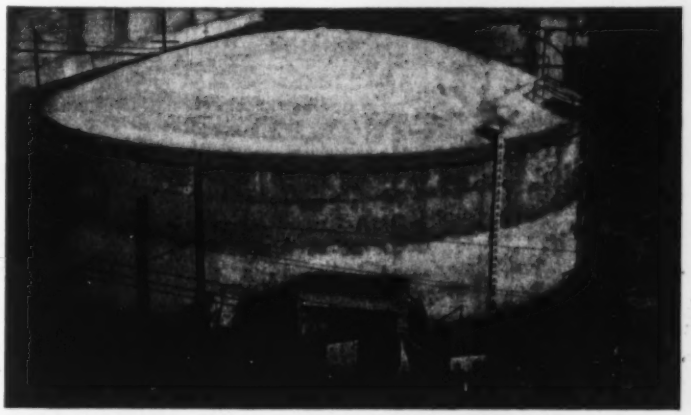
Finishing Machine

A NEW, IMPROVED Model B-1 Concrete Floating-Finishing Machine is announced. A successor to the Whiteman Model B, the original Finishing Machine, it offers the tested features of this model plus many important improvements. Ball



Concrete Floating Finisher

thrust bearings have been added at the top and bottom of the handle making trowel adjustment far easier with the machine in motion. A new Timken bearing-equipped gear case gives smoother, more efficient operation and reduces wear. A new safety switch on the handle shuts finisher off automatically when operator releases grip, providing greater safety. Trowel adjustment arms are protected from concrete by a new rubber collar. It also features snap-on float trowels. It is available with 4-cycle gas engine, single or 3-phase electric motor. **Whiteman Manufacturing Co., CE 6-115, 3249 Casitas Ave., Los Angeles 39, Calif.**



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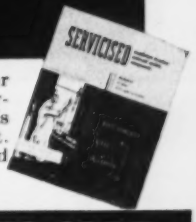

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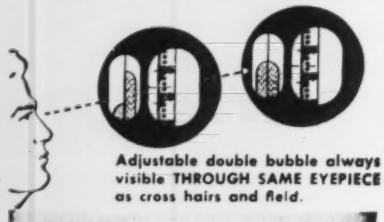

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Literature Available

POWER HYDRAULIC CONTROLS FOR SHOVEL CRANE—A twelve page booklet, "The Inside Story of Today's Most Advanced Shovel-Crane Control System," has just been released. It describes the operating and maintenance advantages of "Speed-O-Matic" which is said to increase shovel-crane output 25%. Cartoons, diagrams, exploded views and on-the-job photographs are included. A copy of "The Inside Story" (book no. 2424) will be furnished on request by **Link-Belt Speeder Corp., CE 8-116, Cedar Rapids, Iowa.**

NEW APPROACH TO LAND CLEARING OPERATIONS—A specialized, profitable approach to land clearing is described in Bulletin No. 21. The two-color folder describes heavy duty, electrically controlled and operated land clearing equipment. The two paramount members of the LeTourneau land clearing line, the LeTourneau Tree Saw and the LCTractor, are pictured. Also pictured in the bulletin is the LeTourneau Harrow, a heavy duty implement drawn by the LCTractor and designed especially for breaking up newly cleared virgin land. One of the pages of Bulletin No. 21 is a cost analysis sheet. On it, the necessary information can be developed for figuring ownership cost and operating cost of a LeTourneau Tree Saw. **R. G. LeTourneau, Inc., CE 8-116, Longview, Texas.**

MANY USES FOR ASPHALTIC COATINGS—An eight page booklet which provides considerable coating information, in easily read form, is now being offered. In addition to rust prevention, the booklet names the following uses for Insul-Mastic reinforced asphaltic coatings: Vaporsealing thermal insulation, waterproofing building walls, dampening sound and vibration, controlling condensation and insulating. It is available by asking for Booklet GM-100. **The Insul-Mastic Corp. of America, CE 8-116, 1141 Oliver Building, Pittsburgh 22, Penna.**

MODEL 20 SHOVELOADER—Just published is a condensed picture catalog on the new Model 20 Shoveloader, a rubber-tire tractor loader with a standard bucket capacity of 12 cu ft. Designed for the economical handling of bulk chemicals, sand, dry materials, castings, scrap, etc., the Model 20 has an "all-in-one" packaged power train that helps reduce original purchase price and simplify maintenance. The catalog contains other specifications, data and action diagrams. **Baker-Lull Corp., CE 8-116, 314 W. 90th St., Minneapolis 20, Minn.**

INSTRUMENTATION AND CONTROL FOR WATER FILTRATION PLANTS—"Instrumentation and Control for Water Filtration Plants," bulletin #100-K2, has been issued. This sixteen page bulletin describes the complete line of equipment for water treatment plants and includes many sketches of typical instruments of flow meters, gauges and rate of flow controllers. For a copy write **Builders-Providence, Inc., CE 8-116, 345 Harris Ave., Providence 1, R. I.**

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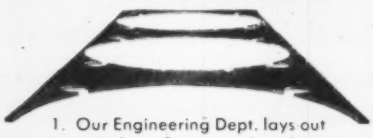

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Literature on request

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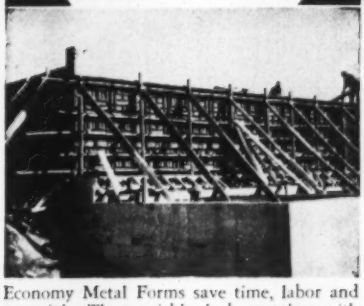

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ECONOMY FORMS

metal forms for concrete construction

Literature Available (Continued)

IMPROVED ROADS—A new booklet "The Calcium Chloride Road" is being offered to road officials. Designed for the practical road man, this new booklet describes in non-technical language how gravel, crushed stone and other similar types of road can be converted and maintained as smooth, dust-free riding surfaces without increasing present budgets. Illustrated with many how-to-do-it photographs, the new booklet covers such phases of the subject as: how to plan a Calcium Chloride Road; how to convert roads lacking sufficient binder soil or aggregate; drainage; blading and shaping; application of calcium chloride; and seasonal maintenance. In addition, the booklet shows how the Calcium Chloride Road fits into a program as the intermediate type of improvement between the dusty unimproved road and the more expensive paved surface. Copies of this new booklet may be obtained without charge by addressing requests to the Advertising & Sales Promotion Department, **Solvay Process Division, Allied Chemical & Dye Corp., CE 8-117, 61 Broadway, New York 6, N. Y.**

CRAWLERS—A new descriptive bulletin, (73SC-B), covers the recently introduced Lima Type 703-SC lifting crane, available on crawler, truck or wheel mount. On crawlers, the new unit has a lifting capacity of 50 tons at twelve ft radius with a 50-ft boom and a capacity of 2,875 lb at 110-ft radius with a 130-ft boom. Crawlers are 18 ft six in. in length and 14 ft two in. in width. Working weight is approximately 117,900 lb. **Baldwin-Lima-Hamilton Corp., CE 8-117, Lima, Ohio.**

HOW TO OPERATE A MOTOR GRADER—An instructive 20-page illustrated action booklet on how to operate a motor grader has just been issued. The booklet is attractively printed in four colors. While the booklet is especially interesting to Galion grader owners, much of the instructive material is expected to be a real aid in improving the skill of grader operators generally. Some subjects covered are hydraulic control system, steering, tips on leaning the front wheels, position of the blade, reverse blading bank sloping, etc. A free copy of the booklet may be obtained by writing: **The Galion Iron Works & Mfg. Co., CE 8–117 Galion, Ohio, or any of their distributors.**

DOMER LOADER—A four page descriptive folder on Domor Loaders for Caterpillar D2 and D4 tractors has just been released. The D2 and D4 Loaders feature full track oscillation, extra-high lift, quick detachability and a wide range of buckets. The Loaders are designed for any type of material handling and general farm use. Descriptions and specifications are fully illustrated in the attractive new folders. Literature is available through Caterpillar-Domor dealers or by writing direct to **Ulrich Products Corp., CE 8-117, Roanoke, Ill.**

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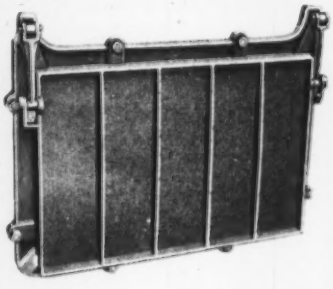

Fig. B-61. Type M-M

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397. Discussions of PROCEEDINGS-SEPARATES 158, 183, 187, 201, and 219. (ST)

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458. Airfield Pavement Design of the Corps of Engineers, by Gayle McFadden. (AT) The great progress in the development of airfield pavement design during the past decade has followed the changing trend of airplane design. In this paper are outlined the general rules used by the Corps of Engineers, United States Department of the Army, in the design of both rigid and flexible pavements to support present-day heavy loads. The author describes the procedures based on the Westergaard, California Bearing Ratio, and Marshall methods. Detrimental frost action is considered. Design curves illustrating these procedures are presented for discussion.

459. Discussion of Proceedings-Separates 163, 191, and 196. (AT)

460. Drainage in the Humid Areas of the United States, by John G. Sutton. (IR) The purpose of this paper is to acquaint the engineer with the needs and current problems inherent in drainage in humid areas. Improvements resulting from drainage programs are described. In the paper are outlined the functions of the various agencies responsible for the drainage programs. Drainage for agricultural purposes and the special drainage programs in Louisiana and North Dakota are studied. Important problems and needs in this field are outlined.

461. Diversion of Canals, by Hassan M. Ismail. (IR) The design of a proper diversion between branch and main canals aids in controlling the distribution of sediment between them. This paper describes tests of a model to find the effect of the shape of canals and of the ratio of flows in them on the velocity distribution in the branching region. A relatively high velocity in the main canal requires greater curvature at the diversion point in order to avoid separation, the author found. Secondary currents are greatly increased with the velocity ratio, causing a large quantity of sediment to enter the branch. High relative velocity in the branch is recommended to reduce separation and secondary currents, and thus reduce the quantity of branch sediment.

462. Factors Influencing Irrigation in Humid Areas, by Tyler H. Quackenbush. (IR) Irrigated agriculture in the eastern United States, if properly guided, offers one of the largest potentials available for increasing productivity of cropland and pasture land. Some of the data most urgently needed by the field engineer for the preparation of a more adequate design for irrigation systems in the humid areas are those concerning water supply and its physical control, relationships between soil and moisture, irrigation water requirements, methods of water application, and drainage. The need for more adequate water laws is emphasized.

463. Discussion of Proceedings-Separates 319, 347, 369, and 404. (IR)

464. Prospective Sites for Large Steam Plants, by Norman F. Williams. (PO) The general area for a proposed steam electric plant for a utility system is usually selected from a consideration of present loads, deficit load areas, future load growths, fuel costs, transmission line losses, transmission requirements, etc. Having selected the general area, the engineering and other factors which must be evaluated in choosing the final site in this general area are pointed out and discussed.

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Acker Drill Company, Inc. 111
Wm. Ainsworth & Sons, Inc. 23
Allis-Chalmers Manufacturing Company . . . 87, 108 and 109
American Bitumuls & Asphalt Company 16
American Bridge Division 20
American Cast Iron Pipe Company. 21
American Concrete Pressure Pipe Association 19
American Steel & Wire Division . . . . . 112 and 113
Jack Ammann Photogrammetric Engineers 25
Armco Drainage & Metal Products, Inc. 5

Borden Metal Products Company 2
Wm. Bros. Boiler & Mfg. Co. 29
Brown & Brown, Inc. 118

Cast Iron Pipe Research Association . . . . . 104 and 105
Caterpillar Tractor Co. . . . . 96 and 97
Cement Gun Co. 115
Chicago Bridge & Iron Company 13
Columbia-Geneva Steel Division . . . . . 6, 7, 112 and 113
Concrete Reinforcing Steel Institute 95

Drilled-In Caisson Corporation 100

The Earle Gear & Machine Company 103
Economy Forms Corp. 117
Eimco Corporation . . . . . 14 and 15

Fennel Instrument Corp. of America 116
Flexible Sales Corporation 103

Hardinge Company, Incorporated 23

C. L. Guild Construction Co. 9

Imperial Tracing Cloth. 101
The Ingalls Iron Works Company 26
International Harvester Company . . . . . 89, 90, 91 and 92
Irving Subway Grating Co., Inc. 116

Johns-Manville Corporation 17

Kern Instruments, Inc. 102
Keuffel & Esser Co. 101
The Kinnear Mfg. Co. 28

Lefax 117
Lehigh Portland Cement Company 1
The James Leffel & Co. 99
Leupold & Stevens Instruments, Inc.. 94
Lock Joint Pipe Company . . . . . 4th cover
Lone Star Cement Corporation 32

The Master Builders Co. . . . . 3rd cover
Mayo Tunnel & Mine Equipment 101
Moretrench Corp. 23

National Pool Equipment Co. 101
Naylor Pipe Company 98
Newport News Shipbuilding and Dry Dock Company . . . 12

Pennsylvania Drilling Co. 117
Pittsburgh-Des Moines Steel Co. 30
Portland Cement Association 8

Raymond Concrete Pile Co. . . . . 2nd cover

The Salem Tool Company 117
Seaman Motors Inc. 4
Servicised Products Corp. . . . . 115 and 118
Semoloid Company Inc. 102
Sika Chemical Corp. 27
Spencer, White & Prentis, Inc. 23
Sprague & Henwood, Inc. 111
Superior-Lidgerwood-Mundy Corporation 18
Symons Clamp & Mfg. Co. 101

Tennessee Coal & Iron Division . . . . . 6, 7, 112 and 113
The Texas Company 11

United States Pipe and Foundry Co. 10
United States Steel Corporation . . . . . 6, 7 and 20
United States Steel Export Company . . . 6, 7, 112 and 113
David White Company 94
Henry Wild Surveying Instruments Supply Co. of America, Inc. 118
R. D. Wood Company. 22

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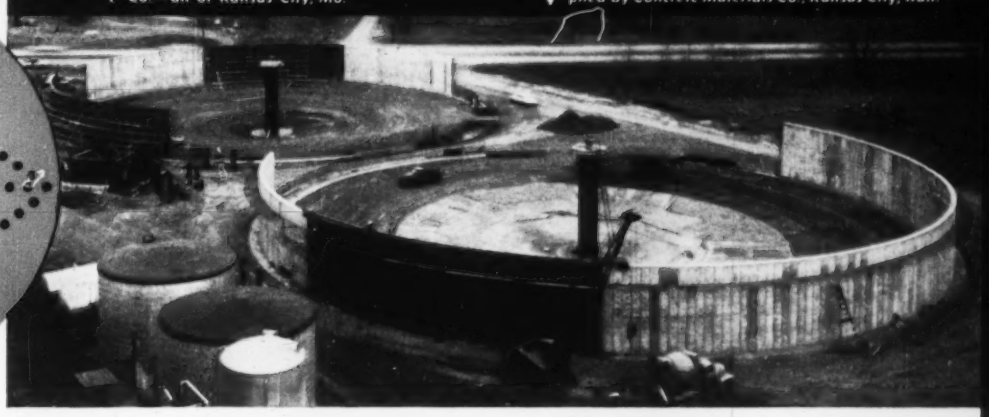

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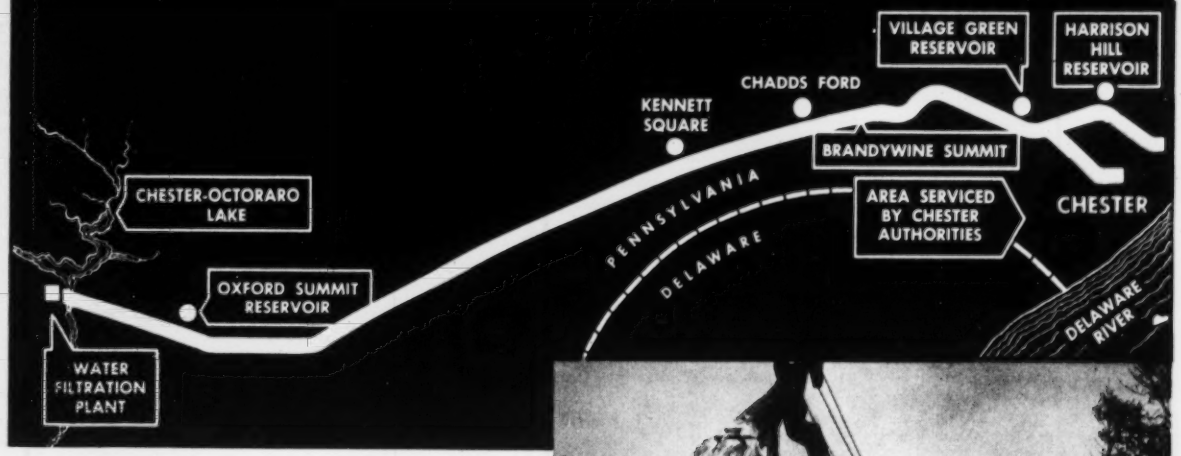

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